14 AUGUST 2018

Skagway Ore Basin Risk Assessment

Submitted to:
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PO Box 435
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Distribution:

1 electronic copy – White Pass & Yukon Route Railway
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REPORT

Executive Summary

What was the issue?

Previous investigations had documented the presence of lead, zinc and mercury at concentrations that exceeded sediment guidelines for the protection of benthic organisms. The magnitude of these exceedances was considerable in some samples, and the pattern of contamination indicated that the ore concentrate handling facility was the likely source. Consequently, some previous investigations have recommended that the Ore Basin needed to be dredged as a priority action.

What was the goal of the investigation?

A decision to dredge based only on total sediment concentrations is not necessarily based on an understanding of risk. The risk associated with a contaminant source will be influenced by bioavailability, spatial extent, and other considerations. Golder designed and executed a supplemental sampling program to help inform risk-based management. This program included sediment transport analysis, sediment chemistry, toxicity testing (baseline and toxicity identification evaluation) and tissue chemistry. All available data (historical and data collected by Golder) were assessed using a risk assessment approach consistent with State guidance.

What did we learn about hazards to aquatic organisms?

The preliminary sediment transport analysis showed that the site is largely depositional and likely receiving inputs of clean sediment from the Skagway River. There are some areas where propeller scouring appears to be occurring, but they are limited in spatial extent and do not appear to overlap with the areas with highly-elevated ore concentrations. The sediment chemistry data collected by Golder supports the sediment transport analysis. Concentrations of ore-related metals in the current surface sediment of the Ore Basin are lower than previous investigations.

Toxicity testing was conducted to find out if sediment caused negative effects to benthic organisms. A battery of three different toxicity tests to represent different parts of the benthic community was used. Samples for toxicity testing covered the range of concentrations in the current surface sediment and included samples from elsewhere in Skagway Harbor as well as reference areas. Many of the samples showed an unacceptable effect, even though the concentrations of ore-related metals and polycyclic aromatic hydrocarbons did not exceed conservative guidelines for the protection of benthic organisms.

A toxicity identification evaluation was completed on a subset of samples which confirmed that ore-related metals such as copper, lead, zinc and mercury were not causing toxicity. This conclusion was supported by statistical analysis which showed there was not a statistically significant relationship between ore-related metals in sediment and the effects observed in the toxicity tests. The conclusion is also consistent with the findings from a toxicity identification evaluation completed by a previous consultant. Golder concluded that sewage inputs (including ammonia) may be exerting a negative effect on sediment quality in the Ore Basin based on the balance of available information.

What did we learn about metal bioaccumulation in shellfish?

Although ore-related metals do not appear to be exerting direct toxicity on benthic organisms, the mass of the contamination present in sediment is still influencing aquatic food chains. Tissue samples were collected for mussels, shrimp and crabs from within the Ore Basin, elsewhere in Skagway Harbor, and at reference areas.

There were species-specific differences in how metals are being accumulated, which is expected based on differences in feeding strategy and home range mobility. Overall, concentrations in mussels appear to be decreasing over time.

What did we learn about hazards related to shellfish consumption by people?

All seven of the ore-related metals exceeded conservative screening values for the consumption of shellfish. Exceedances of these screening limits were also observed in samples from the reference area, but overall, concentrations of metals related to ore concentrates were higher in at least one tissue sample collected from the site relative to reference concentrations.

The presence of a maximum concentration that exceeds a conservative screening value does not necessarily mean that there are risks to people consuming shellfish from the harbor. The preliminary sampling also showed that there were a small number of shellfish samples that were also accumulating polycyclic aromatic hydrocarbons, and that metals unrelated to ore concentrates also exceeded the conservative screening values in some samples. Further sampling to determine a defensible average concentration in the specific shellfish types being consumed may be appropriate and would be necessary to provide a more refined evaluation regarding risks to humans.

Further risk evaluation, if conducted, should also consider administrative controls on shellfish consumption. Administrative controls are a common element of risk management plans for contaminated sediment. Golder understands that shellfish harvesting from Skagway Harbor is not permitted because of the presence of the municipal wastewater discharge.

What did we learn about hazards related to shellfish consumption by wildlife?

Golder concludes that there are low hazards to birds and mammals that could consume shellfish from the site from ore-related contaminants. The food chain model used conservative, no-observed effect toxicity reference values and assumed that the receptor would obtain 100% of their food from a given area. Realistically, receptors would consume prey items harvested over a much larger area than the Ore Basin. The model also assumes that 100% of the tissue concentrations are absorbed by the animal through its gastrointestinal tract when in fact, a large proportion of the ingested dose is passed through the wildlife and is not absorbed by the gastrointestinal tract. Golder concluded that it was reasonable to use the average tissue concentration based on all tissue samples (from a given area) under these circumstances because otters and oystercatchers are expected to consume all three prey types (crabs, mussels and shrimp) from all parts of a given area. Further refinement of the food chain model to evaluate different dietary proportions would not be expected to substantially change this conclusion. However, Golder notes that average tissue concentrations were used in the model because there were insufficient tissue samples available from each area to allow for the calculation of a more conservative exposure estimate (e.g., the 95th upper confidence limit of the mean), and therefore, the model should be updated with any additional tissue data that might be collected as part of a post-remedial monitoring program to confirm that these conclusions continue to be valid.

What are the major sources of uncertainty in this conclusion?

Any risk management decision based on this risk evaluation should consider the uncertainty associated with both the underlying data and how it was evaluated. Uncertainty is present in all environmental assessments, and therefore, steps are taken through the assessment process to minimize uncertainty to the extent possible, and then to describe the residual sources of uncertainty clearly so that risk managers and regulatory decision-makers can balance those factors in deciding an appropriate course of action. Methodological uncertainty in chemistry and toxicity data was minimized by applying accepted procedures for quality assurance and quality control during all stages of data acquisition. No substantive quality issues were identified during the investigation that would limit the utility of the data for making a site management decision. Data that were collected with variance from standardized protocols (such as chemical analysis on archive samples outside the hold-time) are identified in the report and the merits of considering such data discussed. In those instances, data are typically treated as a qualitative indicator. Other sources of uncertainty include study design topics such as the number and spatial coverage of sampling. Tissue sampling, for example, was limited in this respect, but still appropriate for a screening-level risk assessment. Risk assessment is inherently a tiered process, and therefore, conservative assumptions and guidelines were applied throughout the risk evaluation to avoid erroneously concluding that a risk is present if in fact it is not. In a screening-level risk assessment, the goal is to eliminate issues that do not require further consideration based on a conservative evaluation. Issues that cannot be eliminated at the screening level do not necessarily present an actual risk, and the decision to proceed with a more refined risk evaluation would typically be done in conjunction with a remedial options analysis.

What are the next steps?

Golder concludes that metals are not the major cause of adverse effects observed in the toxicity tests, although ore-related metals are accumulating in the portion of the aquatic food chain that was assessed. This conclusion was based on a robust toxicity testing program in conjunction with a specialized toxicity identification evaluation process. Additional toxicity testing or assessment of the benthic community structure in the Ore Basin are not considered likely to change this conclusion.

Further discussion with the appropriate regulatory agency about the value of conducting a more refined evaluation of human health exposures is recommended. The main uncertainty relates to the fact that the human health calculation was completed on a relatively small number of samples (which is appropriate for a screening-level assessment). The screening-level risk assessment identified several issues that may relate to wastewater discharges that are subject to other state regulatory processes and have approved initial dilution zones that encompass the Ore Basin. Wastewater management practices may already have resulted in administrative controls that would mitigate the human health exposures via the shellfish consumption pathway. Notwithstanding the technical rationale to refine some elements of the risk assessment, Golder acknowledges that that there may be practical or operational considerations regarding the need to dredge some parts of the Ore Basin. Removal of a portion of the mass of metals related to ore concentrates would be expected to further reduce the potential uptake of these metals by shellfish and follow-up sampling of shellfish tissue concentrations as part of post-remedial monitoring is considered appropriate. These data can be used to provide more information about potential hazards to human health and wildlife as described in this report.

In terms of remedial design, Golder notes that the available data are not sufficient to establish a quantitative relationship between mass removed and future tissue concentrations, nor is it likely that such a relationship would be developed in the future. However, the limits of the volume to be dredged should not be established using default sediment guidelines because multiple lines of evidence in the assessment have established that metal bioavailability to benthic organisms is substantially lower than the assumptions that are inherent in the guideline derivation.

Study Limitations

This report (the “Report”) was prepared for the exclusive use of White Pass & Yukon Route for the express purpose of providing an indication of the environmental condition of the Site. In evaluating the Site, Golder Associates Ltd. has relied in good faith on information provided by others as noted in the Report. We have assumed that the information provided is factual and accurate. We accept no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or fraudulent acts of persons interviewed or contacted.

Any use which a third party makes of this Report, or any reliance on or decisions to be made based on it, are the sole responsibility of the third parties. If a third party require reliance on this Report, written authorization from Golder is required. Golder disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The scope and the period of Golder’s assessment are described in this Report, and are subject to restrictions, assumptions and limitations. Except as noted herein, the work was conducted in accordance with the scope of work and terms and conditions within Golder’s proposal. Golder did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Report. Conditions may therefore exist which were not detected given the limited nature of the assessment Golder was retained to undertake with respect to the Site and additional environmental studies and actions may be required. In addition, it is recognized that the passage of time affects the information provided in the Report. Golder’s opinions are based upon information that existed at the time of the writing of the Report. It is understood that the services provided for in the scope of work allowed Golder to form no more than an opinion of the actual conditions at the Site at the time the site was visited, and cannot be used to assess the effect of any subsequent changes in any laws, regulations, the environmental quality of the site or its surroundings.

The findings and conclusions documented in this report have been prepared for the specific application to this project, the services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

The content of this report is based on information collected during our environmental sampling, our present understanding of the Site, and our professional judgment in light of such information available at the time of this report. This report provides a professional opinion, and therefore no warranty is either expressed, implied or made as to the conclusions, advice and recommendations offered in this report. This report does not provide a legal opinion regarding compliance with applicable laws. With respect to regulatory compliance issues, it should be noted that regulatory statutes and the interpretation of regulatory statutes are subject to change.

Table of Contents

TABLES

FIGURES

APPENDICES

List of Commonly Used Abbreviations and Acronyms

ADEC	Alaska Department of Environmental Conservation
AIDEA	Alaska Industrial Development and Export Authority
ALS	ALS Laboratory Group, Environmental Division
ASTM	American Society for Testing and Materials
AVS	Acid Volatile Sulphide
CRM	Certified Reference Material
CSL	Cleanup Screening Levels
DL	Detection Limit
DO	Dissolved Oxygen
DQO	Data Quality Objective
DRO	Diesel Range Organics
HPAH	High Molecular Weight PAH
LPAH	Light Molecular Weight PAH
PAH	Polycyclic Aromatic Hydrocarbons
PSEP	Puget Sound Estuary Program
QA/QC	Quality Assurance / Quality Control
RPD	Relative Percent Difference
RRO	Residual Range Organics
SAP	Sampling and Analysis Plan
SCO	Sediment Cleanup Objective
SEM	Simultaneously Extractable Metals
TIE	Toxicity Identification Evaluation
TOC	Total Organic Carbon
USEPA	United States Environmental Protection Agency
ww	Wet Weight
WDOE	Washington State Department of Ecology
WPYR	White Pass & Yukon Route

1.0 INTRODUCTION

1.1 Project Context

White Pass & Yukon Route (WPYR) railway engaged Golder Associates Limited (Golder) to provide risk assessment and risk management services related to sediment issues in the Skagway Ore Terminal Basin (the "Ore Basin" or the "site") located in Skagway, Alaska. The site has been the subject of multiple environmental investigations dating back to at least 1984. A broad conclusion that the Ore Basin requires immediate dredging to remove sediment contamination has been described by some of the previous investigators. Golder was requested to review the available site data, identify and address data gaps, and present the totality of data in the context of the practices and principles established by regulatory guidance and the scientific literature around sediment toxicology and risk assessment. The objective (as defined by WPYR) was to provide a science-based analysis of the potential risks to human and ecological receptors as a result of the current surficial sediment contamination in the Ore Basin to assist them to make informed decisions about the timing, nature and magnitude of potential remedial activities.

To meet this objective, Golder has:

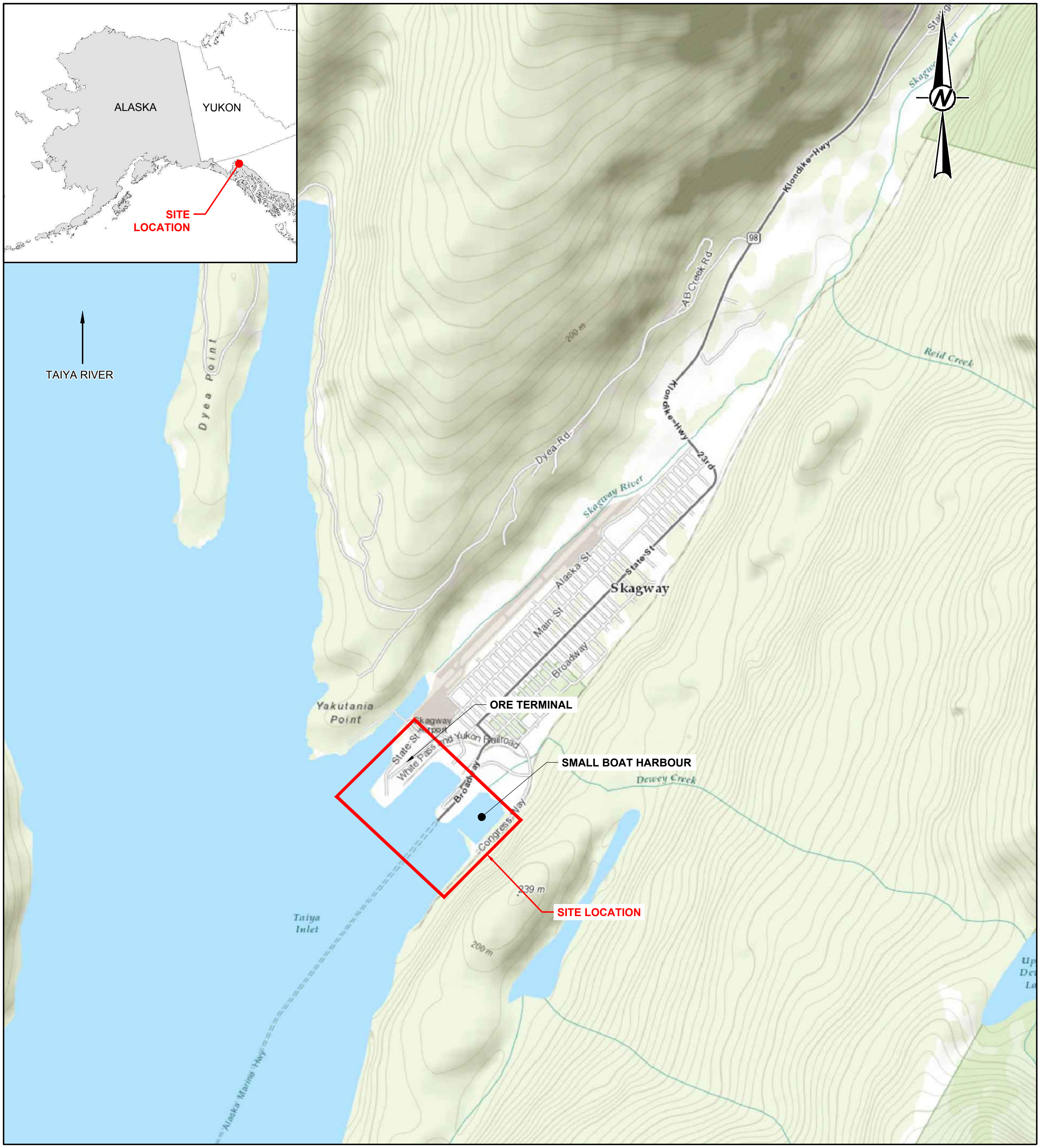
- Reviewed previous reports and Site data to identify data gaps.
- Conducted a supplementary sediment sampling program.
- Evaluated the available data in a risk assessment context to determine if contaminants related to ore handling activities were contributing to unacceptable risks to humans or aquatic organisms near the site.
- Provided recommendations regarding risk assessment or risk management considerations that could be integrated into site management planning.

1.2 Site Description

Skagway Harbor lies at the terminus of a deep fjord (Lynn Canal) on the historical alluvial fan of the Skagway River. The harbor consists of a limited near-shore zone with a typical water depth of between 30 and 40 feet which transitions rapidly to deeper water in Lynn Canal (Anchor 2015). The site location is provided in Figure 1. The shoreline of Skagway Harbour was established through dredging and filling in the early 1900s (Tetra Tech 2008). Changes to the harbour configuration involved construction of the Small Boat Harbour (circa 1958), the State Ferry Terminal (circa 1963), and the expansion of the Ore Terminal (circa 1968), all of which involved dredging and use of the dredged material (Anchor 2015). A brief summary of the history of site activities (Anchor 2015) is provided as further context for the sampling program:

- The Ore Terminal portion of the harbour was leased by WPYR from the Municipality of Skagway in the late 1960s and was used for the trans-shipment of lead and zinc ore concentrate from the Faro Mine using an open conveyor system between 1967 and 1982.
- Sporadic use of the facility for shipping ore concentrates continued between 1982 and 1997 with a variety of terminal operators. The conveyor system was enclosed in 1991.

- A concrete dock was added in 2000 to allow the facility to be used by cruise ships, and the historical ore concentrate building was demolished in 2003. A new concentrate building was constructed and has been used for shipment of copper concentrates from the Minto Mine since 2007.
- The terminal is currently operated by Alaska Industrial Development and Export Authority (AIDEA). Infrastructure includes a fuel depot (operated by Petro Marine Services) and a container facility (operated by Alaska Marine Lines) in addition to the ore concentrate shipping and cruise ship docking.



REFERENCE

BACKGROUND IMAGE SOURCES: ESRI, HERE, DELORME, TOMTOM, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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WHITE PASS AND YUKON ROUTE

PROJECT
OREBASIN SEDIMENT ASSESSMENT
SKAGWAY, ALASKA

CONSULTANT

Golder Associates

YYYY-MM-DD	2018-07-16
PREPARED	RTJ
DESIGN	LC
REVIEW	PM
APPROVED	BM

TITLE
SITE LOCATION

PROJECT No.	PHASE	Rev.	FIGURE
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1.3 General Approach for Risk Assessment

Risk assessment is a structured approach to assemble and interpret environmental data. The general approach for ecological and human health risk assessment is described in multiple guidance documents from federal (e.g., United States Environmental Protection Agency) and state (e.g., Alaska Department of Environmental Conservation [ADEC]) agencies. Sediment-specific technical guidance is also available from Washington State Department of Ecology [WDOE]) as well as from the scientific literature. The scientific literature on how to integrate and interpret different types of data obtained during sediment investigations into an overall conclusion is relatively robust, and originates with the sediment quality triad first described by Long and Chapman (1985). The triad approach has since evolved in a broader weight-of-evidence approach for integrating lines of evidence beyond the classic triad of chemistry, toxicity and benthic community (e.g., Chapman 1990, Chapman et al. 2002; Chapman and Anderson 2005) which in turn has led to the incorporation of explicit weight of evidence approaches in the regulatory guidance for risk assessment (USEPA 2016). The primary guidance manuals consulted during the preparation of this report were:

- "Risk Assessment Procedures Manual" prepared by ADEC (2015). This document outlines how a generic risk assessment process should be applied to contaminated sites risk assessments in Alaska. ADEC (2015) provides checklists and clarity about the expected content of a risk assessment and emphasizes the value of maintaining dialogue with ADEC staff during the risk assessment process. A tiered approach for risk assessment is described.
- "Sediment Clean-up Users Manual" prepared by WDOE (2015). ADEC (2015) provides a process for all contaminated sites whereas WDOE (2015) is specifically intended as a methodology to use chemistry and other lines of evidence to establish numerical clean-up standards. WDOE (2015) also contains technical guidance related to sediment toxicity testing.

The available data considered in this report is consistent with a screening-level risk assessment (ADEC 2015). Sediment chemistry and toxicity data collected during the 2017 field investigation were evaluated following guidance from WDOE (2015). Several specialized approaches (e.g., a sediment transport assessment; a toxicity identification evaluation; measurement of metals in tissue samples) were also used that do not have specific regulatory decision criteria but provide insight into the environmental fate and transport of substances in sediment at the site. An overall conclusion about the magnitude of risks associated with the specific metals associated with ore handling operation was developed based on consideration of all available lines of evidence.

1.4 Report Organization

This report is organized as follows:

- Section 2 – Problem formulation. This section provides a summary of the available data collected prior to 2017 and identifies potential gaps in how that historical data would inform risk-based management decisions. The historical information was used to establish a conceptual site model that describes the contaminants of potential concern, relevant exposure pathways and receptors of potential concern. A conceptual site model helps to focus sampling and investigation activities on the key issues that need risk management.

- Section 3 – Supplemental sampling. This section outlines the methods used in the supplemental sampling, provides a factual summary of the data collected, and discusses the quality assurance / quality control measures that were applied.
- Section 4 – Risk evaluation. This section discusses how the available site data (historical and new data collected in 2017) help to inform our understanding of potential risks to ecological and human receptors Information from the literature was incorporated into this assessment.
- Section 5 – Conclusions and recommendations. This section highlights the main findings of the screening-level risk assessment and discusses how the conclusions help to inform possible risk management alternatives.

2.0 PROBLEM FORMULATION

The problem formulation provides a process to define the scope and objectives of the risk assessment based on the available site information. The goal of the problem formulation is to identify the likely sources of contamination and relevant contaminants of potential concern, identify relevant ecological and human receptors, and describe the exposure pathway between the source and the receptors of potential concern. This information is summarized in a conceptual site model and used to articulate assessment and measurement endpoints that help provide structure and focus to the risk assessment.

2.1 Review of Historical Data

2.1.1 Overview

Several investigations have evaluated the environmental quality in the vicinity of the Ore Basin. Copies of these reports (with supporting appendices, where available) were provided by WPYR, ADEC or the Municipality of Skagway and were reviewed by Golder. A brief overview of the types of data collected is provided in Table 1 and described in more detail in subsequent sections. The locations of historical samples are provided in Figures 2 and 3.

Table 1: Types of Data Collected During Historical Investigations in the Vicinity of the Ore Basin

Document	Sediment Chemistry (Surface Grabs / Cores)			Water Chemistry		Toxicity Testing	AVS	Tissue Chemistry	Benthic Community
	Metals	Hydrocarbons	Grain Size	PW	SW				
RWM (1984)	Yes / NA	—	Yes	—	Yes	—	—	Crabs, mussels, sole	Summary statistics only
SRK (1989)	Yes / Yes	—	Yes	—	—	—	—	—	—
TetraTech (1990a, b)	Yes / NA	Yes / —	Yes	—	Yes	—	Yes	Mussels, sole, sculpin	Visual inspection
Dames and Moore (1995)	Pb and Zn only	—	Yes	—	Yes	—	—	Mussels	Collected, but not analyzed
PND (1999)	Yes / —	Yes /—	Yes / —	—	—	—	—	—	—
PND (2005)	Yes / Yes	Yes	Yes	—	—	—	—	—	—
URS (2006)	Cu, Pb and Zn only	—	—	—	—	—	—	—	—
Gubala (2007)	Yes/Yes	—	—	—	—	—	—	—	—
TetraTech (2008)	Yes / Yes	—	Yes	Yes	Yes	Yes	Yes	Mussels	—
TetraTech (2009)	—	Yes / Yes	—	—	—	—	—	—	—
Gubala (2011)	Yes / Yes	Yes / Yes	—	—	—	—	—	—	—
Gubala (2013)	Yes / Yes (no Cu, Zn)	Yes / Yes	—	—	—	—	—	—	—
Anchor QEA (2015)	Yes / Yes	Yes / Yes	Yes / Yes	—	—	—	—	—	—

Notes: PW = pore water; SW = surface water; AVS = acid volatile sulphides

LEGEND

- ANCHOR QEA SONIC DRILLING LOCATION (SOD)
- GUBALA AND ASSOCIATES SAMPLE LOCATION
- TETRA TECH SAMPLE LOCATION
- URS SAMPLE LOCATION (2006)
- DAMES AND MOORE SAMPLE LOCATION (1995)
- TETRA TECH SAMPLE LOCATION (1990)
- RWM SAMPLE LOCATIONS (1984)
- PERATROVICH, NOTTINGHAM & DRAGE SAMPLE LOCATIONS (1999)

NOTE

ALL SAMPLE LOCATIONS ARE APPROXIMATE

REFERENCES

BASE IMAGE PROVIDED BY THE ALASKA MAPPED PROGRAM (HTTP://WWW.ALASKAMAPPED.ORG) AND UAF-GINA (HTTP://WWW.GINA.ALASKA.EDU).
IMAGE GEOREFERENCED BY GOLDER AND INTENDED FOR INDICATIVE PURPOSES ONLY
DATUM: NAD 83, PROJECTION: UTM ZONE 8

BATHYMETRY DATA PROVIDED BY NOAA
H10972: NOS Hydrographic Survey , Skagway Harbor, Alaska, 2000-05-03

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WHITE PASS AND YUKON ROUTE

PROJECT
SEDIMENT ASSESSMENT PROGRAM
SKAGWAY ORE BASIN
SKAGWAY, AK

TITLE
HISTORICAL SEDIMENT SAMPLE LOCATIONS

CONSULTANT

Golder Associates

YYYY-MM-DD	2018-07-16
PREPARED	RTJ
DESIGN	TR
REVIEW	PM
APPROVED	BM

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LEGEND

- TETRA TECH REFERENCE SAMPLE LOCATION (2008)
- TETRATECH REFERENCE SAMPLE LOCATION (2007)
- PERATROVICH, NOTTINGHAM & DRAGE REFERENCE SAMPLE LOCATION (1999)
- TETRA TECH REFERENCE SAMPLE LOCATION (1990)

NOTE

ALL SAMPLE LOCATIONS ARE APPROXIMATE

REFERENCE

BACKGROUND IMAGE SUPPLIED BY AND SOURCED UNDER LICENSE FROM BING IMAGES FOR ARCMAP ON : SEPT 19, 2016 IMAGE DATE: SEPT, 2010
IMAGE GEOREFERENCED BY GOLDER AND INTENDED FOR INDICATIVE PURPOSES ONLY
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PROJECT
SEDIMENT ASSESSMENT PROGRAM
SKAGWAY ORE BASIN
SKAGWAY, AK

TITLE
HISTORICAL REFERENCE SEDIMENT SAMPLE LOCATIONS

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-07-16
PREPARED	RTJ
DESIGN	TR
REVIEW	PM
APPROVED	BM

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2.1.2 Sediment Chemistry

Evaluation of the Data

There is considerable sediment chemistry data available for the Site and its surroundings in the available historical reports. Observations from a review of the historical chemistry data include:

- There was considerable variability in the surface concentrations between different data sets, despite locations that appeared to be close to each other (e.g., within 15–20 feet). This variability is likely from the ongoing deposition of material (see Section 3.1).
- There are gaps in the historical data—historical sampling was often limited to analysis of metals, and in several instances, specifically limited to lead and zinc. The potential influence of other contaminants has not been fully evaluated—in particular, hydrocarbons. Several historical reports[1] note that hydrocarbons were present in samples, but this did not result in PAHs being systematically assessed.

Data were screened against WDOE (2015) sediment cleanup objective (SCO) and cleanup screening levels (CSL)[2]. The SCO represents a long-term sediment quality goal, while the CSL is a maximum chemical concentration allowed as a sediment cleanup level in a Washington State remedial dredging program in the absence of biological information that demonstrates that effects are not present. There were multiple samples that had lead and zinc concentration greater than the SCO value.

Evaluation of Patterns

Golder concluded that an integrated evaluation of all available historical chemistry data was warranted. The purpose of this compilation was to look for patterns in the distribution of selected contaminants of interest which might indicate likely sources of contamination. If the Ore Basin was identified as a likely source, the goal was to determine a contaminant gradient to help focus the sampling program. Compilation and analysis consisted of the following:

- All data were transcribed into an Excel spreadsheet (provided in Appendix E). Golder relied on the chemistry and depth information as presented in the tables of the original authors and did not conduct an extensive review of certificates of analysis, borehole logs or quality assurance / quality control measures. In some instances, detailed appendices with the original certificates or logs were either not available or had not been prepared by the original author. The depths of samples were not normalized to a theoretical 2017 datum to account for possible changes in the depth of the Ore Basin over time.
- The cumulative hazard associated with the historical chemistry data was evaluated in greater detail by calculating a hazard index. A hazard index is the sum of the individual hazard quotients (i.e., the concentration of zinc in a sample divided by the CSL for zinc). All metals that have a CSL were included in the hazard index

[1] For example, Anchor (2015) found that hydrocarbon concentrations exceeded generic sediment guidelines in two of the samples for the ore basin. Tetra Tech (1990a) commented on the presence of hydrocarbon odours and sheens in a relatively large number of samples collected.

[2] The Apparent Effect Threshold (AET)-based numerical criteria were used per WDOE (2015) guidance to use AET-based criteria when samples have a total organic carbon (TOC) content of less than 0.5%. The average TOC in samples collected from the Ore Basin was 0.2%.

calculation (arsenic, cadmium, chromium, copper, lead, mercury, silver and zinc). Samples were divided into surface (0–6 inches) and near-surface (6–36 inches) groups, and krieging[3] was used to interpolate hazard index values for the entire Ore Basin based on the available data. These interpolations are provided in Figures 4 and 5, and show that:

- There appears to be an area adjacent to the ore conveyor belt where surficial sediment has metals concentrations resulting in a hazard index of greater than 10.
- The size of the area with a hazard index greater than 10 is larger in deeper samples.

- The hazard index data were also used to examine patterns in how different metals contributed to the overall hazard index. Hazard index values were rank-ordered as a stacked-bar chart (Figures 6 and 7). Four “zones” were defined for the purposes of designing the sampling program.
  - Zone A represents a cumulative hazard index value greater than 10. This is the same rule of thumb threshold used in Figures 4 and 5 to identify the area of greatest interest.
  - Zone D represents a cumulative hazard index value of less than 1. This area would not be expected to have significant effects to benthic organisms as a result of metals because all concentrations are less than the conservative screening value.
  - Zones B and C subdivide the remaining area and help to show the gradient of contamination associated with the point-source associated with the ore conveyor belt.
- The distribution of the stacked-bar charts are provided in Figures 6 and 7 and show that:
  - The majority of the calculated hazard index is from lead and zinc, although there are some samples that also have concentrations of arsenic or mercury that have hazard quotients greater than 1. Copper, chromium and silver do not appear to contribute significantly to the hazard index.
  - There was no obvious association between metals and PAHs based on visual inspection. PAHs have a hazard index greater than 10 in several samples which suggests that it may have the potential to cause adverse effects to benthic organisms. The lack of an association indicates that PAHs do not appear to be originating from the ore loading facility.

[3] Kreiging is a statistical approach used to predict values on a continuous surface based on consideration of the relationships between pairs of nearby data points.


LEGEND
ANCHOR QEA SONIC DRILLING LOCATION (SOD)
GUBALA AND ASSOCIATES SAMPLE LOCATION
TETRA TECH SAMPLE LOCATION
URS SAMPLE LOCATION (2006)
DAMES AND MOORE SAMPLE LOCATION (1995)
TETRA TECH SAMPLE LOCATION (1990)
RWM SAMPLE LOCATIONS (1984)
PERATROVICH, NOTTINGHAM & DRAGE SAMPLE LOCATIONS (1999)
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NOTE
- HAZARD QUOTIENTS WERE BASED ON SEDIMENT CLEANUP OBJECTIVES SPECIFIED BY WASHINGTON STATE DEPARTMENT OF ECOLOGY. SEE TEXT FOR THE SPECIFIC METHODS OF CALCULATION
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GA-SH7
GA-14
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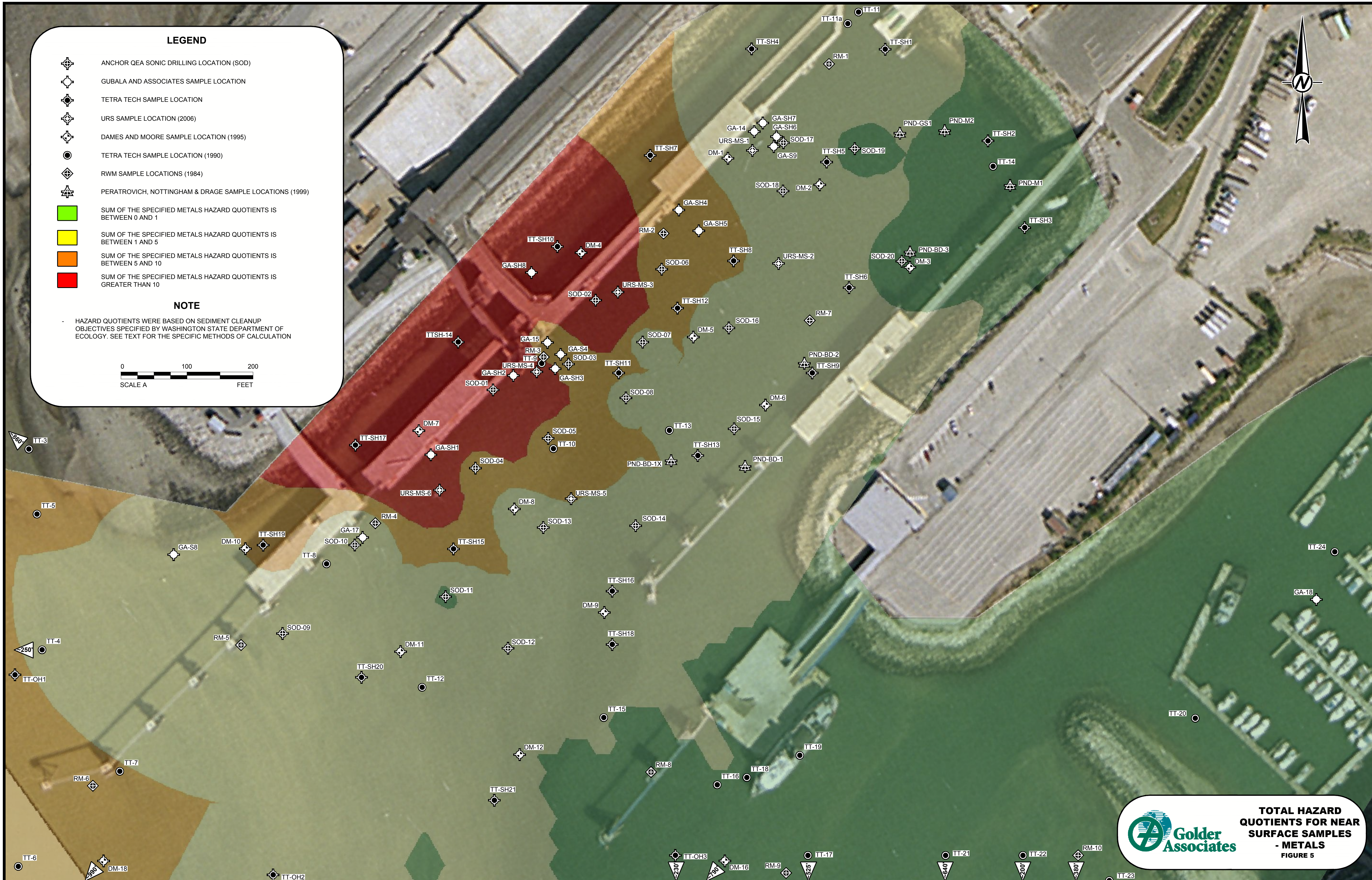
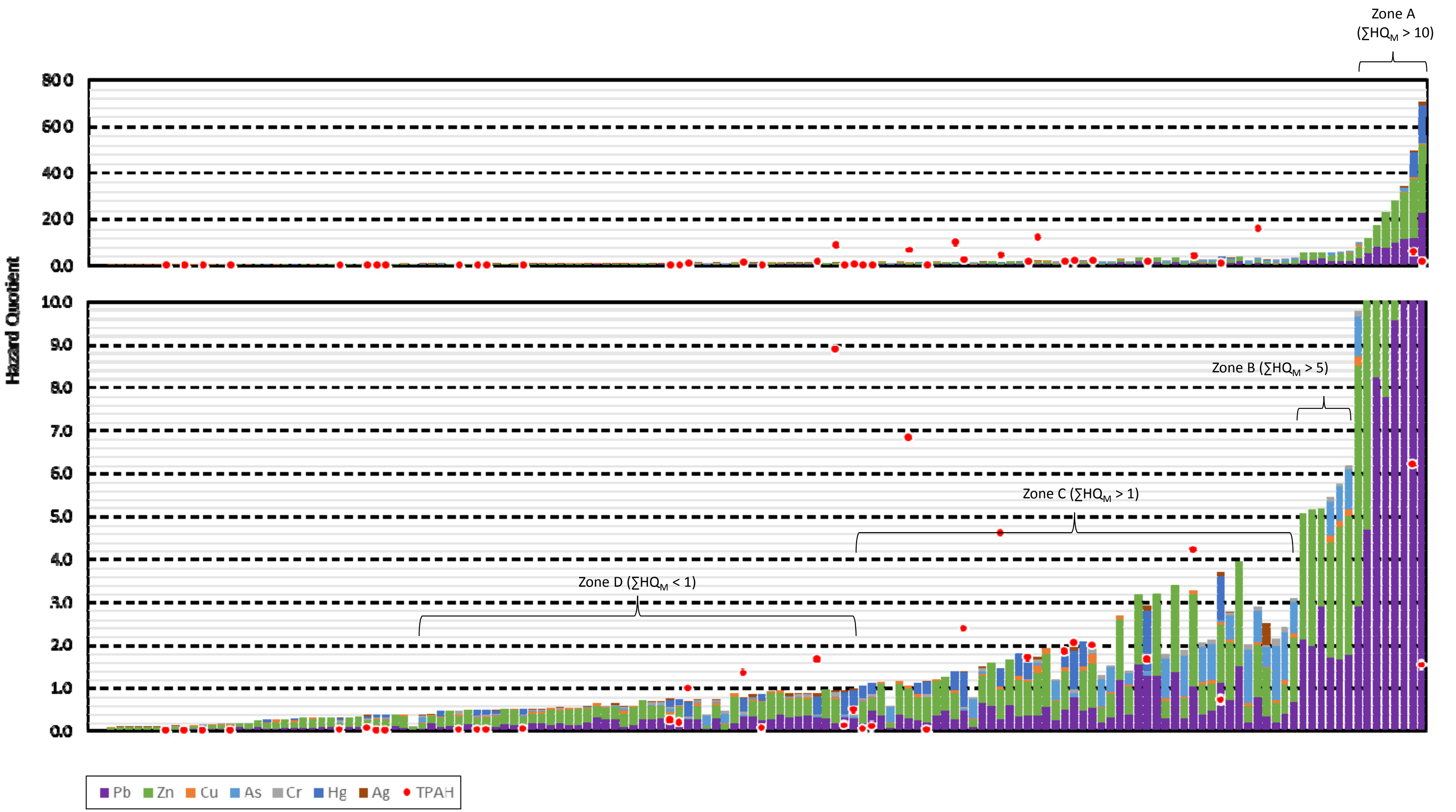
SOD-17
DM-1
GA-S9
TT-SH7
TT-SH5
SOD-19
PND-GS1
PND-M2
TT-SH2
TT-14
SOD-18
DM-2
PND-M1
GA-SH4
GA-SH5
RM-2
TT-SH3
TT-SH10
DM-4
GA-SH8
SOD-06
TT-SH8
URS-MS-2
SOD-20
PND-BD-3
DM-3
URS-MS-3
TT-SH6
SOD-02
TT-SH12
RM-7
SOD-16
DM-5
TTSH-14
SOD-07
GA-15
RM-3
GA-S4
TT-9
SOD-03
URS-MS-4
TT-SH11
PND-BD-2
TT-SH9
GA-SH2
GA-SH3
SOD-01
SOD-08
DM-6
TT-13
SOD-15
DM-7
SOD-05
TT-10
TT-SH13
TT-SH17
GA-SH1
PND-BD-1X
PND-BD-1
SOD-04
TT-3
URS-MS-6
URS-MS-5
TT-5
DM-8
RM-4
SOD-13
SOD-14
GA-17
TT-SH19
DM-10
SOD-10
GA-S8
TT-SH15
TT-8
TT-24
TT-SH16
SOD-11
GA-18
DM-9
SOD-09
RM-5
TT-4
DM-11
SOD-12
TT-SH18
TT-OH1
TT-SH20
TT-12
TT-15
TT-20
DM-12
TT-19
TT-7
RM-8
RM-6
TT-16
TT-18
TT-SH21
TT-6
DM-18
TT-OH2
TT-OH3
DM-16
RM-9
TT-17
TT-21
TT-22
RM-10
TT-23
Golder Associates
TOTAL HAZARD QUOTIENTS FOR SURFACE SAMPLES - METALS
FIGURE 4


LEGEND
ANCHOR QEA SONIC DRILLING LOCATION (SOD)
GUBALA AND ASSOCIATES SAMPLE LOCATION
TETRA TECH SAMPLE LOCATION
URS SAMPLE LOCATION (2006)
DAMES AND MOORE SAMPLE LOCATION (1995)
TETRA TECH SAMPLE LOCATION (1990)
RWM SAMPLE LOCATIONS (1984)
PERATROVICH, NOTTINGHAM & DRAGE SAMPLE LOCATIONS (1999)
SUM OF THE SPECIFIED METALS HAZARD QUOTIENTS IS BETWEEN 0 AND 1
SUM OF THE SPECIFIED METALS HAZARD QUOTIENTS IS BETWEEN 1 AND 5
SUM OF THE SPECIFIED METALS HAZARD QUOTIENTS IS BETWEEN 5 AND 10
SUM OF THE SPECIFIED METALS HAZARD QUOTIENTS IS GREATER THAN 10
NOTE
- HAZARD QUOTIENTS WERE BASED ON SEDIMENT CLEANUP OBJECTIVES SPECIFIED BY WASHINGTON STATE DEPARTMENT OF ECOLOGY. SEE TEXT FOR THE SPECIFIC METHODS OF CALCULATION
0
100
200
SCALE A
FEET
N
Golder Associates
TOTAL HAZARD QUOTIENTS FOR NEAR SURFACE SAMPLES - METALS
FIGURE 5



CLIENT
WHITE PASS AND YUKON ROUTE

PROJECT
STUDY DESIGN AND SAMPLING AND ANALYSIS PLAN
ORE BASIN, SKAGWAY, ALASKA

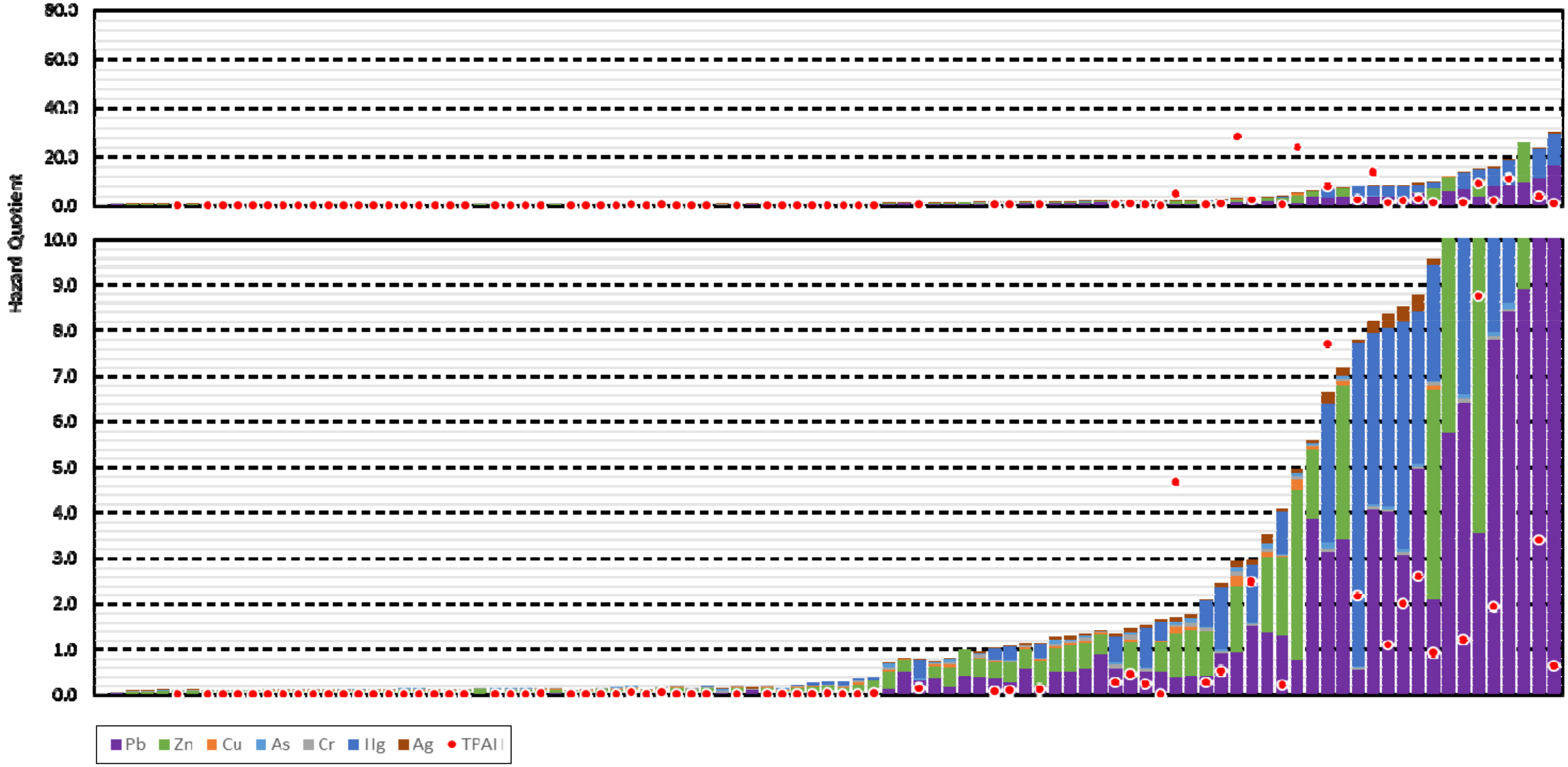
CONSULTANT

Golder Associates

YYYY-MM-DD	2017-02-10
PREPARED	BGM
DESIGN	--
REVIEW	--
APPROVED	--

TITLE
DISTRIBUTION OF HAZARD QUOTIENTS FOR
SURFACE SAMPLES (0 – 6 INCH)

PROJECT No.	PHASE/TASK	Rev.	FIGURE
1657231		0	6



CLIENT
WHITE PASS AND YUKON ROUTE

PROJECT
STUDY DESIGN AND SAMPLING AND ANALYSIS PLAN
ORE BASIN, SKAGWAY, ALASKA

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-02-10
PREPARED	BGM
DESIGN	--
REVIEW	--
APPROVED	--

TITLE
DISTRIBUTION OF HAZARD QUOTIENTS FOR SUBSURFACE SAMPLES (6 – 36 INCH)

PROJECT No.	PHASE/TASK	Rev.	FIGURE
1657231	--	0	7

2.1.3 Sediment Toxicity Testing

Historical toxicity testing was limited to Tetra Tech (2008) from areas near the ore loading facility where worst-case concentrations of lead and zinc have been described (Figure 8). Test methods followed standardized protocols defined by the American Society for Testing and Materials (ASTM International)[4] and appropriate quality assurance / quality control measures were followed. No issues were noted by Golder in terms of the quality assurance / quality control measures and the data are considered reliable and appropriate for use.

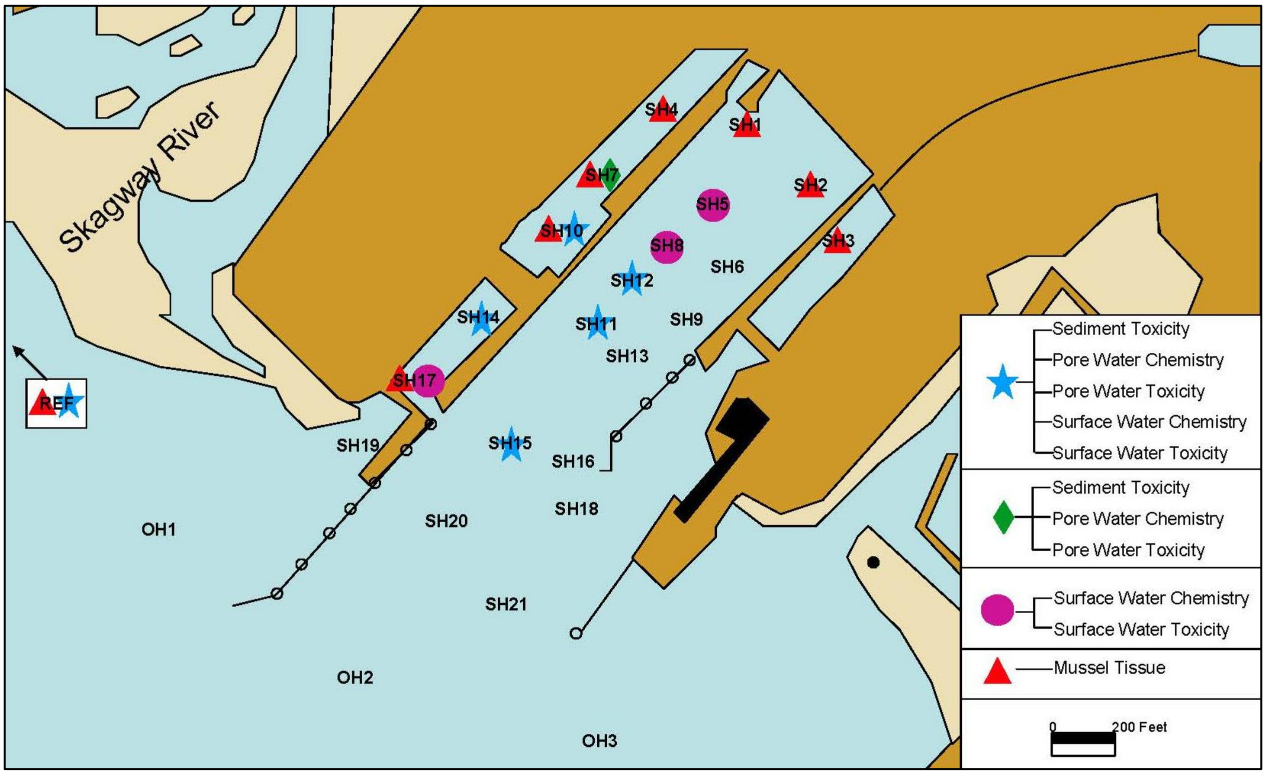


Figure 8: Sediment and Surface Water Toxicity Test Sample Locations (Tetra Tech 2008)

Whole-Sediment Testing

Two whole-sediment toxicity tests (10-d amphipod and 10-d polychaete survival and growth)[5] were completed on six samples from the Site, plus one reference sample. There was no significant decrease in growth relative to the negative control for either species (Tetra Tech 2008), and survival data are summarized in Figure 9.

[4] Although there are USEPA or Washington state test protocols for both tests, the decision by Tetra Tech (2008) is defensible. ASTM test methods are robust and reputable and any actual differences in methodology relative to USEPA or state protocols are minor.

[5] *Leptocheirus plumulosus* and *Neanthes arenaceodentata*

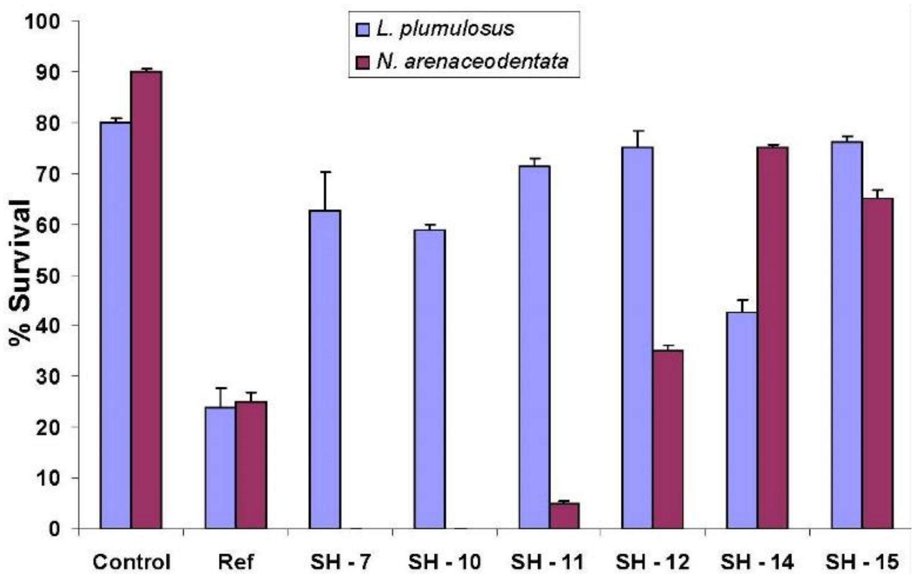


Figure 9: Amphipod and Polychaete Survival (Tetra Tech 2008)

Overall, the reference station was acutely lethal to both species despite not having elevated contaminant concentrations (Tetra Tech 2008). This highlights that physical factors (e.g., coarse grain size, low organic carbon) can lead to a false positive in terms of toxicity testing. All six stations collected from the Site had higher amphipod survival than the reference station (Tetra Tech 2008). Three of the six stations had higher polychaete survival than the reference station, although the three samples that did have a reduction in polychaete survival were also those that were located closest to the ore loading facility (Tetra Tech 2008).

Porewater Toxicity and Toxicity Identification Evaluation

Porewater was extracted from the seven sediment samples for a 96-h shrimp water-only survival test[6]. There were no effects on shrimp survival in SH-14 and SH-15 (Tetra Tech 2008). The remaining four stations (and the reference station) had 100% mortality (Tetra Tech 2008). Dissolved porewater metal concentrations were non-detectable for cadmium and mercury in all seven samples (Tetra Tech 2008). For the remaining metals:

- Copper: 4.2–5.4 µg/L relative to 6.4 µg/L in the reference sample
- Lead: 6.6–20 µg/L[7] relative to a non-detectable concentration in the reference sample
- Nickel: 4.4–15 µg/L relative to 17 µg/L in the reference sample
- Zinc: 9.5–9.7 µg/L relative to a non-detectable concentration in the reference sample.

[6] *Americamysis bahia*

[7] See Table 9 of Tetra Tech (2008). Note that SH-11 was reported to have a total Pb concentration of 6.6 µg/L and a dissolved Pb concentration of 20 µg/L. Dissolved concentrations are unlikely to be greater than total when the analyses are made on the same sample. Concentrations of the other metals had higher total than dissolved concentrations, as expected. Golder concludes that the Pb data for SH-11 was reversed in Table 9, and therefore, 6.6 µg/L is assumed to be the dissolved Pb concentration, not the total concentration.

Tetra Tech (2008) concluded that metals were not likely to cause the observed porewater toxicity because the dissolved metals concentrations were substantially lower than the LC50 or chronic toxicity thresholds reported for the test species. Tetra Tech (2008) also noted that the porewater samples had a high biological oxygen demand, and petroleum sheens and odours.

There was sufficient sample volume from the reference station, SH-7 and SH-11 to conduct a toxicity identification evaluation (TIE). A TIE involves manipulating the sample to remove specific groups of potential toxicants. If the manipulation results in the elimination of toxicity, it suggests that the substance targeted by the manipulation was contributing to the toxicity. Each of the following treatment were run in parallel on different aliquots: 1) addition of EDTA to remove lead, zinc and other select metals[8]; 2) aeration to remove volatile compounds and 3) filtration to remove the possible confounding effect of suspended particles. Tetra Tech (2008) commented that the aeration treatment would not be expected to remove hydrocarbons. The TIE confirmed that toxicity was not related to metals (i.e., adding EDTA to remove lead and zinc did not result in a reduction in toxicity).

Water Toxicity

Two water toxicity tests (48-h larval fish survival and 96-h shrimp survival) were completed on eight samples from Skagway Harbour and one sample from a reference location (Tetra Tech 2008). No effects were observed (Tetra Tech 2008).

2.1.4 Surrogates for Bioavailability

Acid volatile sulfides-simultaneously extractable metals (AVS-SEM) provides a surrogate measurement of bioavailability for metals such as copper, lead, mercury and zinc. The presence of sulfides in porewater reduce metal bioavailability by forming an insoluble precipitate with dissolved metal ions. A sample with more AVS than the sum of SEM is unlikely to have significant concentrations of bioavailable metals in porewater.

Data for AVS was limited to two historical reports:

- Tetra Tech (2008) analyzed 21 surficial sediment samples for AVS-SEM. Seven of the ten samples with measurable AVS were unlikely to have high bioavailability (i.e., there was more AVS than SEM). The remaining samples did not have any measurable AVS.
- Tetra Tech (1990) also measured AVS in 24 samples collected from various parts of Skagway Harbour and found that AVS concentrations were highest in protected areas (e.g., in the small craft harbour or head of the ore basin) or near the municipal sewage outfall. Tetra Tech (1990) did not include SEM analysis, and therefore, no calculation of AVS-SEM ratios can be made.

[8] Ethylenediaminetetraacetic acid (EDTA) forms insoluble precipitates with divalent cationic metals like aluminum, barium, cadmium, cobalt, copper, iron, lead, manganese, nickel, strontium and zinc (USEPA 2007). Other metals such as arsenic are also chelated by EDTA but at a lesser degree than divalent metals.

2.1.5 Bioaccumulation

Tissue sampling was generally limited in terms of the diversity and number of samples collected by historical reports:

- RWM (1984) provide average tissue concentrations for Dungeness crabs, yellowfin sole (liver and muscle) and mussels[9] from the ore basin and the control area at Nakhu Bay. The number of individual samples within each average was not specified. Mussels were collected by divers from pilings and were not depurated. There were no differences[10] in tissue concentrations for lead, zinc, copper, cadmium or mercury for crab or sole. There was an increased concentration for lead and zinc in mussel tissues from within the ore basin relative to the control area, but no difference for copper, mercury or cadmium.
- Tetra Tech (1990a) report tissue concentrations for yellowfin sole muscle (n = 5), yellowfin sole liver (n = 1), sculpin (species unknown; n = 3), and mussels (n = 35; five samples collected from seven locations in the ore basin). Mussels were collected by divers from sediment and depurated for 24 hours prior to analysis. Samples were analyzed for lead, zinc and mercury.
- Dames and Moore (1995) report tissue concentrations for mussels collected from the control area (Nakhu Bay), ore dock and the Broadway dock. One composite sample per area was analyzed for lead and zinc. Mussels were collected from boat by hand from rocks or pilings and were not depurated.
- Tetra Tech (2008) report tissue concentrations for mussels collected from seven locations within the ore basin and a reference area (Taiya Inlet). Mussels were collected by hand from rocks or pilings and depurated for 24 hours prior to analysis. Samples were analyzed for cadmium, copper, lead, nickel and zinc[11]. Tetra Tech (2008) concluded that lead and zinc concentrations increased with proximity to the ore dock.

The observation by Tetra Tech (2008) that tissue concentrations of lead and zinc were higher in mussels collected from the vicinity of the ore dock than those collected elsewhere was generally supported by the other historical data. The historical data is not sufficient to evaluate patterns for other tissue types.

[9] Cancer magister, Limanda aspera and Mytilus edulis.

[10] Statistical significance ($p > 0.05$) using a t-test. Data presented in the report is limited to the mean results by area with a conclusion about statistical significance. Data for individual samples and replicates are not provided.

[11] Mercury was also analyzed but the data were not considered reliable because of poor matrix spike recovery in the QA/QC samples.

2.1.6 Benthic Community Structure

Information about the types and numbers of organisms that are utilizing the available sediment habitat was limited in the historical reports:

- RWM (1984) provide summary statistics for abundance and diversity for three areas ("within" the ore basin; "outside" the ore basin and "control")[12]. The diversity and abundance of benthic organism in the "within" area was reduced relative[13] to the "control" area, as was the diversity and abundance of benthic organisms from the "outside" area. The diversity of benthic organisms was also reduced in the "within" area relative to the "outside" area.
- Tetra Tech (1990a) reported that the benthic community near the ore terminal was "obviously stressed" because there were few organisms present in the two stations that had the highest lead and zinc sediment concentrations. However, Tetra Tech (1990a) also identified at least three other stations without organisms that did not have highly elevated concentrations of metals. Information from Tetra Tech (1990a) is limited to visual inspection of a limited number of samples, and did not involve quantitative analysis by a benthic taxonomist.

2.1.7 Other Historical Information

Anchor (2015) collected data on four composite sediment samples to support a preliminary evaluation of dredge disposal options:

- A sequential batch leaching test (SBLT) was conducted which involves mixing sediment with artificial seawater at a ratio of 1:4, agitating the sample on a shaker table for 24 hours, and then centrifuging the mixture to remove sediment. The process was then repeated three additional times with the original aliquot of sediment to generate four sequentially extracted water samples. Water samples were submitted for chemical analysis (e.g., dissolved metals). Data were compared to the Alaskan ambient water quality guidelines.
- A toxicity characteristic leachate procedure (TCLP) test was conducted which involves an acidic extraction to simulate typical landfill conditions. The leachable concentrations were compared to federal hazardous waste screening limits.

Anchor (2015) concluded that unconfined disposal options that involve continued contact of the dredged material with seawater or freshwater (e.g., open water disposal; placement as upland fill) may be problematic because dissolved metal concentrations in the SBLT exceeded state water quality guidelines. The lead concentrations in TCLP exceeded federal hazardous waste limits which would limit the use of local landfills. Anchor noted that dredged sediment may be appropriate for beneficial reuse in a marine or upland setting if amendments were

[12] Each benthic sample consisted of between 3 and 5 replicates of a Smith-McIntyre grab screened to 0.44 cm^2. There were five "within" samples ranging from 0 to 180 meters from the ore conveyor; five "outside" samples ranging from 200 to 375 meters from the ore conveyor from locations outside the ore basin, and four "control" samples at distances of more than 3,000 meters from the ore conveyor taken from Nakhu Bay.

[13] Statistical significance ($p > 0.05$) using a t-test. Data presented in the report is limited to the mean results by area with a conclusion about statistical significance. Data for individual samples and replicates are not provided.

utilized. A sediment treatability study was completed which demonstrated that the leachability of metals and PAHs could be reduced to levels that met water quality guidelines with the addition of bone meal, ferrous sulfate and Portland cement (Anchor 2016). Confined disposal options have not been evaluated.

2.2 Conceptual Site Model

The conceptual site model integrates information about the sources of contaminants of potential concern, major release mechanisms, operable exposure pathways, and receptors of potential concern into a single figure. The purpose of the conceptual site model is to distill the available information into a more simplified depiction of the key issues that need to be evaluated in a contaminated sites investigation and risk assessment (ADEC 2010)—the conceptual site model evolves over time as new information is obtained. A conceptual site model for the current assessment is presented in Figure 8 to integrate the information about contaminant sources, pathways and receptors described in the following sections.

2.2.1 Contaminant Sources

Sediment quality in an urbanized harbour is influenced by numerous point and non-point sources of contamination that are gradually mixed over time due to sediment resuspension and distribution. The vertical distribution of sediment contamination tends to reflect changes in contaminant inputs over time as older sediment is buried by newer material. The following section describes potential sources of contamination to Skagway Harbor. The current investigation focuses on the ore concentrates that were shipped through the ore handling facility. Previous investigations have tended to focus on lead and zinc, but ore concentrates can also contain other metals depending on the type and quality of ore being concentrated. Skagway Harbour also receives inputs from other sources which may also influence how data collected during the risk assessment should be evaluated. The discussion of other sources is not intended to provide a comprehensive inventory.

- **Metals Associated with Ore Concentrates.** There have been two different sources of ore concentrate:
  - Faro Mine – This material consists of lead and zinc concentrates shipped between 1967 and 1997. The primary contaminants of concern associated with this material are lead and zinc, but other metals are also likely present in the concentrate in varying concentrations. The Faro Mine focused on lead and zinc, but silver and gold were also present in the ore body (Government of Yukon 2013), Historical investigations in Skagway identified arsenic, mercury and cadmium as contaminants associated with the Faro Mine concentrate (ADHSS 1989). The loading system was enclosed in 1991, which means the majority of the lead zinc concentrates were loaded to ships using an open-air conveyor belt system.
  - Minto Mine – This material consists of copper concentrates shipped since 2007. Other metals that are potentially present in the concentrate are gold and silver. This material started shipment after the enclosure of the loading system.

  The primary contaminants of concern for the ore concentrate are expected to be lead and zinc. The Faro Mine concentrate was on the order of 65% lead and 35% zinc (E&E 1989). This material was transported for more than 20 years using an open conveyor belt. Arsenic, cadmium, copper, gold, mercury and silver are also potentially associated with the ore concentrate.

- **Metals and Hydrocarbons from Non-Point Sources** – Metals can also originate from non-point sources in the watershed. Stormwater discharges carry dust and other particulates from roads and parking lots to the harbour (either directly, or indirectly via discharge to Pullen Creek). These non-point sources of metals would likely be of a lower order of magnitude than the point-source associated with the ore loading facility. Hydrocarbons can also originate from point sources (e.g., releases from underground storage tanks to groundwater near the receiving environment) but also from non-point sources (e.g., stormwater runoff, incidental releases from small craft fueling, use of creosote-preserved timbers).

- **Substances Associated with Wastewater Discharges** – A third category of potential contaminant sources to harbour sediment relates to wastewater discharges from municipal or vessel sources. Common substances associated with wastewater discharges include ammonia, biological oxygen demand and coliforms. Other substances can also be present depending on the type of treatment prior to discharge. There are two potential wastewater sources near the Ore Basin.

  - **Municipal Outfall** – The discharge point is located adjacent to the ore basin off the end of the Broadway Dock[14] (Tetra Tech 1988). The facility provides primary treatment. An ambient environment monitoring program conducted in 1999 concluded that there was no evidence of organic material buildup associated with the outfall; however, this assessment was based on two locations (one near the outfall; the other at the edge of a 140-foot diameter initial dilution zone) (USEPA 2002). The municipal wastewater discharge is now subject to a State permitting process[15]. A mixing zone for fecal coliforms of 1,600 meters radial distance from the outfall is required in addition to the 140-foot diameter dilution zone. Shellfish harvesting should not take place within the mixing zone. This 1,600-meter radial mixing zone encompasses the entirety of Skagway Harbor.

  - **Vessels** – Seven large cruise ships are currently authorized to discharge treated wastewater while docked at Skagway. Smaller vessels (e.g., ferries, ships with fewer than 250 overnight berths) are also authorized to discharge provided they have an approved plan[16]. Substances that are typically monitored in vessel wastewater discharges includes ammonia, fecal coliforms, biological oxygen demand, metals (copper, nickel and zinc) and total suspended solids. Ambient water quality monitoring has also been conducted at various locations within Skagway Harbour during discharge events for ammonia, copper, nickel and zinc. Data from 2015 and 2016 showed detectable concentrations of ammonia in water samples collected from all parts of Skagway Harbour.[17] Cruise ships also conduct routine maintenance while in port, which includes hull cleaning below the waterline and painting above the waterline[18].

[14] Coordinates are: 59° 26' 54.8" N, 135° 19' 36.6" W (USEPA 2002).

[15] Information on the permit issued by Alaska Department of Environmental Conservation can be found at: http://dec.alaska.gov/Water/WPSdocs/AK0020010_docs.pdf

[16] E-mail from Edward White, Commercial Passenger Vessel Environmental Compliance Program, Alaska Department of Environmental Conservation, 23 January2018.

[17] Information about cruise ship discharges and monitoring data can be found at: https://dec.alaska.gov/water/cruise_ships/reports.htm. Data for Skagway Harbour ambient monitoring stations was provided via e-mail by Kara Kusche, Alaska Department of Environmental Conservation, 22 November 2016.

[18] E-mail from Edward White, Commercial Passenger Vessel Environmental Compliance Program, Alaska Department of Environmental Conservation, 22 November 2016.

2.2.2 Ecological Receptors

Near-shore marine environments support a wide diversity of different types of organisms. From a risk assessment perspective, the ecological community can be divided into different components that reflect how different organisms would likely interact with metals and other contaminants associated with sediment:

- Benthic invertebrates – Examples of benthic invertebrates include amphipods, polychaetes (worms) and other taxa that burrow into the sediment. Benthic invertebrates are exposed to sediment contaminants through a variety of mechanisms, including direct contact with porewater and ingestion of sediment particles. The specific taxa that inhabit sediment within the ore basin will be influenced by depth, substrate type and the level of physical disturbance.
- Sessile epibenthic invertebrates – An example of a sessile epibenthic invertebrates (i.e., those associated with the surface of sediment) are mussels. Mussels are immobile, and attach to pilings, rocks or other submerged hard surfaces. These taxa are exposed to sediment contamination primarily through ingestion of suspended sediment particles which they filter from the water column.
- Mobile epibenthic invertebrates – Example of epibenthic invertebrates include crabs, seastars and shrimp. These taxa are exposed to sediment contamination primarily through their diet, or through ingestion of suspended particulates.
- Dermersal fish – These are typically small-bodied fish like sole or sculpin that would occupy near-bottom habitats and are exposed to sediment contamination through their diet. Home ranges tend to be smaller than larger fish, which can increase their exposure.
- Pelagic fish – These are typically larger fish like salmon that would be exposed via dietary consumption. Home ranges tend to be larger, which can limit their exposure to a localized area of sediment contamination.
- Wildlife – There are numerous bird and mammal species that consume shellfish and fish. The specific exposure of a given wildlife receptor depends on the degree to which a sediment contaminant is bioaccumulating in the tissues of prey items. Habitat ranges tend to be very large which limit their exposure to a localized area of sediment contamination.

2.2.3 Human Health Receptors

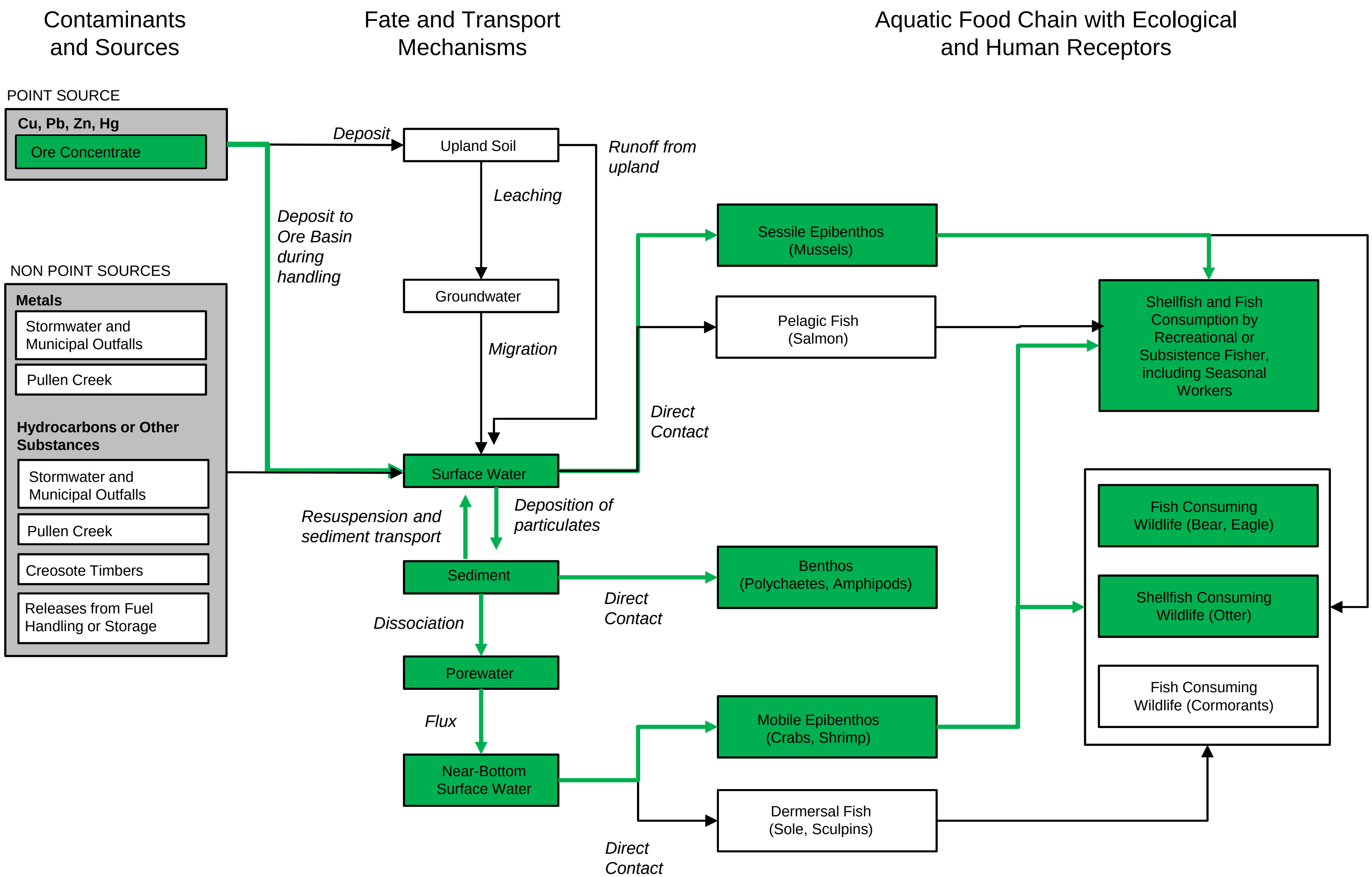
People can be exposed to sediment-related contaminants in a variety of ways, depending on how they interact with the marine environment. The site is located within an urbanized/industrial harbour that has been constructed on placed material. Intertidal areas are steep, and predominantly consist of rip-rap and engineered structures. There were no significant intertidal areas with sands noted that would likely lead to direct contact or ingestion of sediment during recreational activities. Field personnel observed people fishing and setting crab and prawn traps throughout the harbour (i.e., within the 1,600-meter mixing zone associated with the municipal outfall where harvesting is not considered to be appropriate). The following exposure scenarios for humans were identified:

- **Resident**: This scenario considers a resident who lives in Skagway and catches shellfish from the harbour for consumption. Receptors for this scenario include adults and children of all ages.

- **Seasonal Resident**: This scenario considers a seasonal resident who works in Skagway for six months of the year during the tourist season (i.e., May to October, inclusive). It was assumed that they would consume shellfish from the harbour during their stay. Receptors for this scenario include teens and adults.
- **Recreational Fisher**: This scenario is similar to the resident, but considers a person who more regularly catches shellfish from the harbour for consumption. Receptors for this scenario include adults and children of all ages.

2.2.4 Release Mechanisms

As noted above, sediment tends to accumulate contaminants from a variety of sources which then gradually mix over time depending on sediment transport dynamics. Point-sources of sediment contamination tend to create “hot spots” in contaminant distributions within an overall background level of contamination that reflects non-point sources. This interaction between point-sources and sediment transport dynamics is particularly relevant in the current assessment because the ore dock (the point source for metals related to ore concentrates) overlaps with sources of wastewater. In terms of specific release mechanisms related to the ore concentrate, ADHSS (1989) noted that historical ore handling activities involved significant fugitive dust releases from the conveyor system (prior to its enclosure). Deposited ore dust near the conveyor system was reportedly swept from the docks (ADHSS 1989). Ore concentrate would have a higher specific gravity than dust originated from native soils. The net effect of these release mechanisms would be likely a hot spot in the immediate vicinity of the ore conveyor belt where fugitive dusts would be deposited directly to the ocean, surrounded by an area where fugitive dusts were swept or rinsed from the dock or ships, surrounded by a larger area where deposited material would be subject to resuspension and distribution over time through sediment transport dynamics.



Notes:
See text for discussion regarding inoperable pathways.
Aquatic food chain has been simplified for illustrative purposes.
Risk assessment focuses on primary pathways related to ore concentrates (marked in green).

CONCEPTUAL SITE MODEL – SKAGWAY ORE BASIN

Golder Associates

PROJECT No. 1657231			FILE No. ----	
DESIGN	BGM	2JAN18	SCALE NTS	REV.
CADD	--		**FIGURE 10**	
CHECK				
REVIEW	XXX			

2.3 Data Gaps

As described in Section 2.1, the Ore Basin and its surroundings have been the subject of multiple investigations dating back more than 20 years. A broad conclusion that the Ore Basin requires immediate dredging to remove sediment contamination has been described by some previous investigators (Gubala 2011, 2013) which in turn led to the development of a preliminary dredge design and treatability study (Anchor 2015, 2016). The historical data is sufficient to conclude that ore concentrates have contributed to elevated concentrations of multiple metals (primarily, lead and zinc, but also other metals such as mercury) in sediment. These concentrations exceeded conservative screening limits in multiple samples, and concentrations of ore-related metals tended to increase with proximity to the ore handling facility. However, there were data gaps identified during the review that could influence risk management planning:

- There was conflicting information about whether concentrations of ore-related metals in sediment were increasing or decreasing over time through sediment transport. A sediment transport analysis was not part of the historical information.
- Although there was sufficient information about the vertical and horizontal distribution of copper, lead and zinc in sediment based on the totality of samples collected (see Appendix A for the distribution of these three metals), many historical samples were limited to these primary contaminants of concern. There were limited data for other metals, and only a moderate number of measurements of concentrations of other contaminants of potential concern (such as polycyclic aromatic hydrocarbons).. Multiple historical studies excluded analysis of samples for hydrocarbon concentrations. The available data show that there are exceedances of numerical screening limits for polycyclic aromatic hydrocarbons (PAHs) in several locations. The source of these hydrocarbons has not been conclusively established, but is likely consistent with other harbors where PAHs are related to the use of creosote preservatives and releases of petroleum products.
- Historical toxicity data were limited to one study (Tetra Tech 2008) which appeared to show that adverse effects in standardized toxicity testing were not related to metal concentrations in sediment. Information on the diversity, abundance and biomass of resident benthic organisms was also limited.
- Historical tissue chemistry data were also limited, both in terms of the diversity of sampling types, as well as spatial coverage. Mussels were the most frequently sampled organism. Several authors commented there was a general spatial pattern with tissue concentrations of lead and zinc higher in mussels collected from the vicinity of the ore dock relative to those collected elsewhere.

2.4 Problem Formulation Conclusions

A problem formulation and conceptual site model was developed based on a review of the available historical information for the site. Data gaps were identified for further investigation (described further in Section 3) to support risk management planning for the contaminated sediment known to be present within the Ore Basin. The problem formulation identified that contaminants related to ore concentrates were not necessarily limited to only lead, zinc and copper. Other metals that are potentially associated with the ore concentrate are arsenic, cadmium, gold, mercury and silver. There are other non-point sources of metals present in Skagway Harbour, and other substances that have the potential to contribute to adverse effects to the aquatic environment were identified (hydrocarbons, and substances such as ammonia that are related to municipal outfall or other sources).

A conceptual model was used to identify the primary exposure pathways to be considered in a screening-level risk assessment. Benthic invertebrates (e.g., amphipods, polychaetes and other burrowing organisms) were identified as the primary ecological receptor of concern because they would be in direct contact with sediment and porewater. Other ecological taxa (e.g., mussels, crabs and shrimp) were also identified as relevant receptors, although the exposure of some taxa like crabs and shrimp to ore-related contaminants in sediment may be limited because they are mobile and can forage over larger areas. Fish and wildlife species that consume fish or shellfish are relevant receptors. Human receptors were also identified as relevant in terms of potential exposure to ore-related sediment contamination through consumption of shellfish (crabs, shrimp and mussels) from the site. Direct contact between human receptors and ore-related contamination was not considered to be an operable pathway.

3.0 SUPPLEMENTAL INVESTIGATIONS

This section describes a brief overview of the approaches and major findings from three supplemental investigations conducted by Golder Associates:

- Screening-level sediment transport analysis (Winter 2016). A desktop review of site information was completed to provide an assessment of the potential for natural processes to re-suspend sediment from within the Ore Basin. An assessment of the influence of vessel propellers to scour and re-suspend bedded sediment was also completed. The purpose of this investigation was to determine if the Ore Basin was predominantly erosional or depositional in nature.
- Supplemental field investigation (Summer and Fall 2017). A field investigation was conducted to collect surface grab samples for toxicity testing and chemical analysis from multiple locations in Skagway Harbour (and off-site reference areas). Shrimp, crab and mussel tissue samples were also collected. Two rounds of a toxicity identification evaluation were completed to determine the cause of the sediment toxicity observed in some samples.
- Sediment core sampling (Fall 2017). A second field investigation was conducted to obtain additional information about the vertical distribution of sediment contaminants. Coring was completed using a truck-mounted rig on a landing craft, with sampling focused on the vicinity of the ore-loading facility, with additional cores along the dock frontage.

Further details (e.g., sampling and analysis plan; quality assurance / quality control measures, field data summaries, certificates of analysis from the contract laboratories; tabular summaries) can be found in the respective appendices. All available data (historical and supplemental information collected by Golder) was then evaluated in terms of its implications for site management using a screening-level risk assessment which is discussed in Section 4.

3.1 Sediment Transport Analysis

The sediment transport analysis using existing data is provided in Appendix A. The scope of the assessment was limited to the readily available information and did not include direct measurements at the site to determine the travel distance or locations where re-suspended sediment (from propeller scour) or suspended particulates (from wastewater discharges) would likely accumulate over time. In brief:

- A review of the site history and background with respect to shoreline reconfiguration and dredging was conducted using existing data. The site was constructed on deltaic deposits in 1969 by placement of dredged material. The eastern portion of the Ore Basin by the Broadway dock was dredged in 1995, 1999 and 2005. Substrate descriptions from previous investigations generally show that sediment consists of a proportion of fine material accumulating over time, especially near the ore terminal. This fine-grained material overlays a gravelly sand which is interpreted as the relict deposits from the Skagway River prior to construction of the harbour.

- Sea level data from the Skagway NOAA monitoring station between 1945 and 2015 and bathymetric surveys between 1943 and 2014 were obtained and used to determine changes in bathymetry over time. Bathymetric analysis showed that the total sediment deposition between 1990 and 2015 in the western side of the Ore Basin was between 0.4 and 0.9 m (1.3–3.0 feet), even when the uncertainty in older bathymetric data and isostatic rebound was accounted for. The eastern side of the Ore Basin showed an aggregate increase in depth over the same time due to repeated dredging.
- Sediment inputs from the Skagway River were considered. The interaction of freshwater from the Skagway River with marine water creates a saltwater wedge which would create a mechanism for fine-grained material to be deposited in the Ore Basin during a flooding tide. Visual confirmation of this deposition mechanism was identified in site photographs.
- The potential for resuspension of bedded material in the Ore Basin was assessed. Typical wind-generated waves, wind-driven currents and tidal currents do not have sufficient energy to re-suspend significant amounts of sediment from within the Ore Basin. An extreme wind-generated wave and storm surge event (e.g., a 1 in 50 year) event would be needed to re-suspend sandy and silty material. Propeller wash from a tugboat, bulk ore carrier or cruise ship has sufficient energy to re-suspend bedded material. However, the spatial extent of the area subject to propeller scouring is limited—the energy from the propeller activity rapidly disperses over distance. High-resolution bathymetric images were available from 2014, and three distinct depressions are evident in locations that may correspond to expected locations for ships tied at dock and tugs used to assist cruise ships. The size of these scour depressions was limited in spatial extent (consistent with the calculations), and were not located in areas with highly elevated metals concentrations.

Overall, the conclusion from the desktop-level sediment transport analysis is that the site is predominantly depositional, and that fine-grained material from the Skagway River will gradually accumulate in the Ore Basin over time, especially near the ore dock. This material is relatively stable, and unlikely to be re-suspended unless located within specific, limited areas where propeller scouring may occur. This broad conclusion based on consideration of the available historical information was reviewed based on observations from the field sampling program. There are areas where grab sampling did not successfully penetrate the sediment, and therefore, direct evidence of the grain size distribution in those areas is not available. Some of these areas may be cobble, which would be expected in the vicinity of the scour depressions noted above. Grain size distribution in the samples that were collected from the Ore Basin by Golder were predominantly sandy (average percent sand: 51%) with a significant fraction of fine-grained material (average percent clay + silt: 39%). One sample collected from the Ore Basin (of the 16 samples in total) was predominantly a gravel (48%) which is consistent with the desktop conclusion that the area is predominantly depositional with a few areas of propeller scouring. Coring along the face of the Ore Dock (see Section 3.3) also confirmed that there is a thick depositional layer of fine-grained material overlying a sandy layer. Golder concluded that the field observations from the sampling program were consistent with the findings from the screening-level sediment transport analysis. The conclusions from the sediment transport analysis were not solely dependent on grain size distributions or visual observations. The conclusions also considered the mechanistic basis for material from the Skagway River being deposited in the Ore Basin (which was reinforced by photographs showing that deposition occurs) as well as the analysis of changes in bathymetric data.

3.2 Supplemental Surface Sampling Program

The purpose of this section is to provide a concise overview of the supplemental field program conducted by Golder in May 2017. The field program included:

- Preparation of a sampling and analysis plan for review and approval by ADEC prior to the start of field sampling activities (Appendix B).
- Preparation of a field data report (Appendix C) to meet the requirements of ADEC (2016) in terms of documenting the specific methods used and quality assurance / quality control measures taken.

A brief overview of the study design is provided below to describe how the study design was executed in the field, and provide a brief factual overview of the different types of data collected. Specific references to the field data report (Appendix C) are made where appropriate to provide reviewers with further details regarding sample methodology, field observations, datasheets, certificates of analysis and quality assurance / quality control evaluation. Interpretation of the available data from a risk assessment perspective is provided in Section 4.

In brief, the supplemental field program consisted of the following:

- The available historical data was used to establish a gradient of contamination that could be reasonably attributed to ore concentrate handling activities. This was done using the hazard index calculation described in Section 2.1.2 (i.e., the sum of hazard quotients for ore-related metals was calculated for individual surficial locations and then extrapolated to the remainder of the Ore Basin using krieging).
- The gradient of ore-related contamination was divided into four zones based on the magnitude of contamination[19]. Each zone was targeted for four to fivesamples to provide spatial coverage of the zone. Each sample was intended to involve multiple grab samples for surficial sediment (which were then composited and subdivided in chemistry and toxicity aliquots) and replicate samples for benthic community analysis[20]. Sediment was collected from a total of 24 stations[21] from the following areas:
  - Zone A – Four samples
  - Zone B – Five samples
  - Zone C – Three samples
  - Zone D – Four samples
  - Zone E (Other parts of Skagway Harbor) – Three samples
  - Zone F (Reference areas[22]) – Five samples

  Benthic community samples were also collected and archived from 14 of the 24 stations (Figures 12 and 13).

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[19] Zone A – The hazard index is greater than 10; Zone B – The hazard index is greater than 5; Zone C – The hazard index is greater than 1; Zone D – The hazard index is less than 1.

[20] It was not possible to collect benthic community samples at all locations because of substrate and time limitations.

[21] See Section 3 of Appendix C for a detailed description of the sample collection, handling, storage and transport methods.

[22] Reference locations were selected to match reference areas previously sampled in historical investigations. Targeted locations were Dyea Point, near the mouth of the Taiya River, and at the head of Nakhu Bay. See Section 2.2.2 of Appendix A for more information.

- All 24 stations were analyzed for chemistry (metals, PAHs, grain size, organic carbon). Hazard index values for the ore-related metals were less than 10 in all samples (i.e., the worst-case samples collected in 2017 were consistent with Zone B). Fourteen stations were selected for sediment toxicity testing to represent the range of concentrations of metals and PAHs. Toxicity testing consisted of three different tests (10-d amphipod survival; 20-d polychaete survival and growth; 96-h sea urchin larval development). Testing included samples with a range of ore-related metal concentrations, as well as three samples from reference areas.
- Three of the stations were ultimately selected for a porewater toxicity identification evaluation based on the outcome of the sediment toxicity testing. The benthic community samples were archived but were not analyzed as part of the current scope of work based on the outcome of the toxicity identification evaluation.
- Crab, mussel and shrimp tissue samples were collected from three different areas (Figure 14). Crab and shrimp traps were deployed throughout the sampling program, and mussels were collected from hard surfaces accessible by hand from the sampling vessel. All tissue samples were analyzed for metals and PAHs. The total number of samples were:
  - Near-field (inside the Ore Basin): Prawns (n = 5), crabs (n = 3), mussels (n = 5)
  - Mid-field (outside the Ore Basin but still in Skagway Harbor): Crabs (n = 5), mussels (n = 5)
  - Reference: Prawns (n = 3), crabs (n = 3), mussels (n = 5).
- Field quality assurance / quality control measures included the use of field duplicates as well as trip, field and equipment blanks. Laboratory quality assurance / quality control measures included laboratory duplicates and matrix spikes for the chemical analysis, and the use of negative controls and reference tests in the toxicological analysis. Further discussion of the specific quality assurance / quality control data is provided in Appendix C. Overall, the data was considered to be reliable, representative and suitable for use.
- Site photographs, field records, laboratory certificates of analysis and laboratory review checklists are included in Appendix C following the guidance from ADEC (2016).

It was not possible to collect all 31 sediment stations identified in the sampling and analysis plan because of weather delays, challenges in achieving adequate grab penetration in some locations, and the impending arrival of large vessels. The plan was to collect sufficient sediment from each station for chemical analysis with sufficient volume held as an archive for toxicity testing. Benthic community samples for archiving were also planned for all 31 stations. Ultimately, Golder was able to collect all three study components from a majority of locations but opted to focus on sediment chemistry (with toxicity archive) as the field program progressed. Golder concludes that the absence of seven stations[23] was not a significant limitation because the sampling was still able to achieve adequate spatial coverage within the Ore Basin and included all zones from the underlying gradient of ore-related contamination. There were still sufficient samples from which to select representative locations for toxicity testing.

[23] All proposed sample locations were assigned a sample ID which was retained irrespective of whether a location was successfully sampled. SED17-02, SED17-04, SED17-16, SED17-23, SED17-25, SED17-26 and SED17-30 were not sampled, and therefore, those IDs do not contain data in this current data report.

The reduced number of stations for benthic community analysis did not impact the study quality because benthic community analysis was ultimately not used as a line of evidence. The locations where sampling components were not collected (relative to the original study design) are identified on figures in Appendix E.

3.3 Sediment Core Sampling

Based on a review of existing site data, ten locations near the Ore dock were selected for subsurface investigation to complement the surficial sediment sampling completed for the risk assessment and other recent coring data to ultimately provide more information when conducting remediation planning.

Sampling was conducted in late October 2017. A total of ten stations were sampled for metals, hydrocarbons and sewage indicators with additional sample volume archived for potential future testing. The drill rig operated by Aquasource LLC of Haines, AK was positioned on board a landing craft, with drill rods placed through the gap at the hinge when the 17' long bow ramp was lowered down parallel to the water. The landing craft was tied to the dock and the seven locations (SED17-32 to SED17-35 and SED17-39 to SED17-41) along the ore dock were measured to be at a distance of 17 feet from the dock (i.e., the vessel would position itself such that the ramp was pushing against the dock pilings). A second row of samples (SED17-36 to SED17-38) was collected at a distance of 75 feet (i.e., the length of the vessel held in position by reversing against the pilings) from the dock.

Three main sediment units were identified during the subsurface sediment sampling program:

- All sample locations along the dock intersected a layer of black organic mud that transitioned from being very soft to soft. This mud had a hydrogen sulfur odour and commonly contained biota (e.g., mussel shells, tube worms). This layer of organic sediment was found at a thickness ranging from 2.5 to 6.7 feet. The soft mud was not encountered in the three sample locations located 75 feet from the dock.
- A unit of brown silt and fine sand ranging between 0.2 and 1.2 feet thick was present beneath the organic mud near the dock and as the surficial unit in the locations 75 feet from the dock. Some mussel shells were also found mixed in with this sediment unit.
- Underlying the silt and fine sand sediment was a light grey, coarse sand and gravel unit extending to the maximum depth investigated.

The laboratory data was screened against numerical standards (SCO: sediment cleanup objective, and CSL: cleanup screening levels) as described by the Washington State Department of Ecology (WDOE 2015). Data are provided in Appendix D, but overall, the majority of samples had one or more ore-related metals that exceeded the SCO values.

The highest concentrations were associated with lead, zinc, mercury and copper, and were typically found in the organic mud (shallow samples) and the silt and fine sand unit (mid-level samples) collected along the dock, to a maximum depth of approximately 7.7 feet below mudline with the highest concentrations occurring adjacent to the ship loader. In the samples collected in the step out locations from the dock, directly across from the ore loader, high concentrations of lead and zinc were present in the silt and fine sand unit (middle unit) to a maximum depth of approximately 5.5 feet below mudline as the organic mud was not present.

The highest concentrations of metals are co-located. The locations with high concentrations of lead also have high concentrations of zinc and elevated concentrations of mercury and cadmium. The areas near the loading dock also contained elevated concentrations of copper and silver. The following graphic shows the spatial distribution of the magnitude of lead concentrations with depth along the Ore Dock (left to right) and across the Ore basin. The figure indicates that the highest concentrations are localized near the Ore loader while the majority of the Ore Basin is less than the SCO and CSLs.

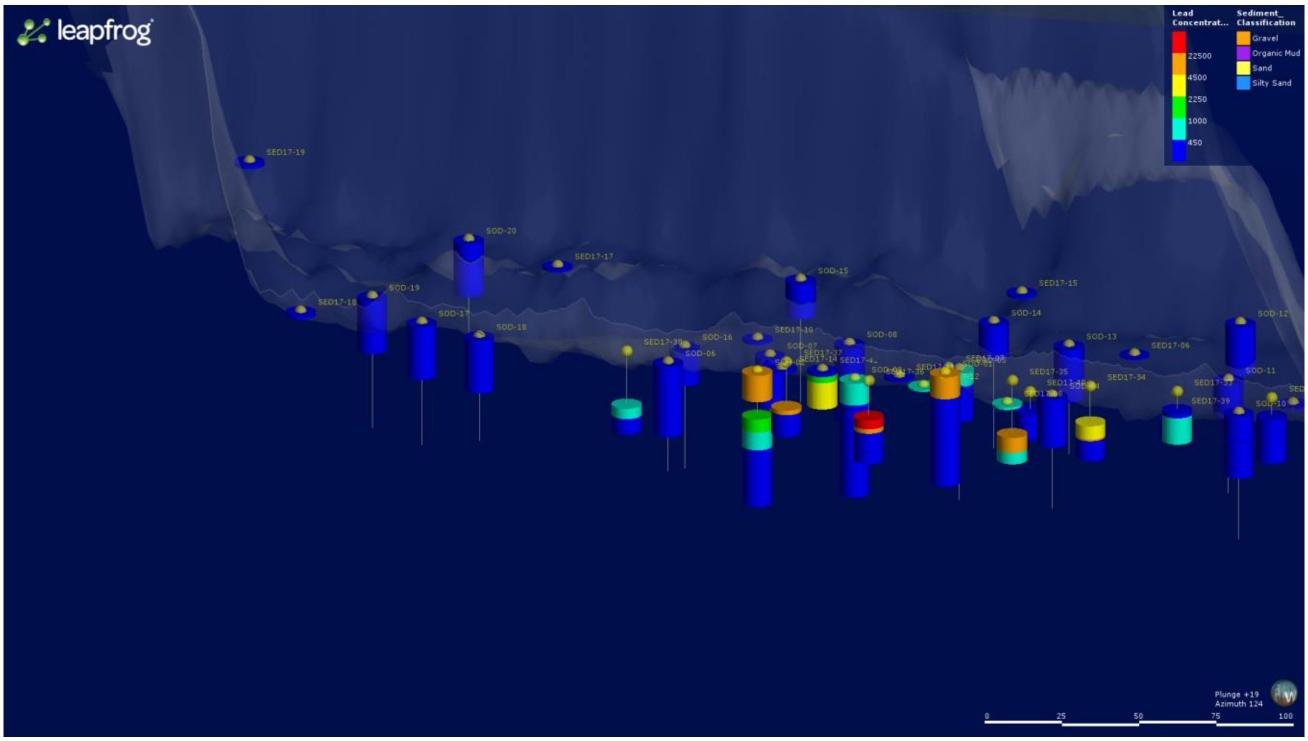


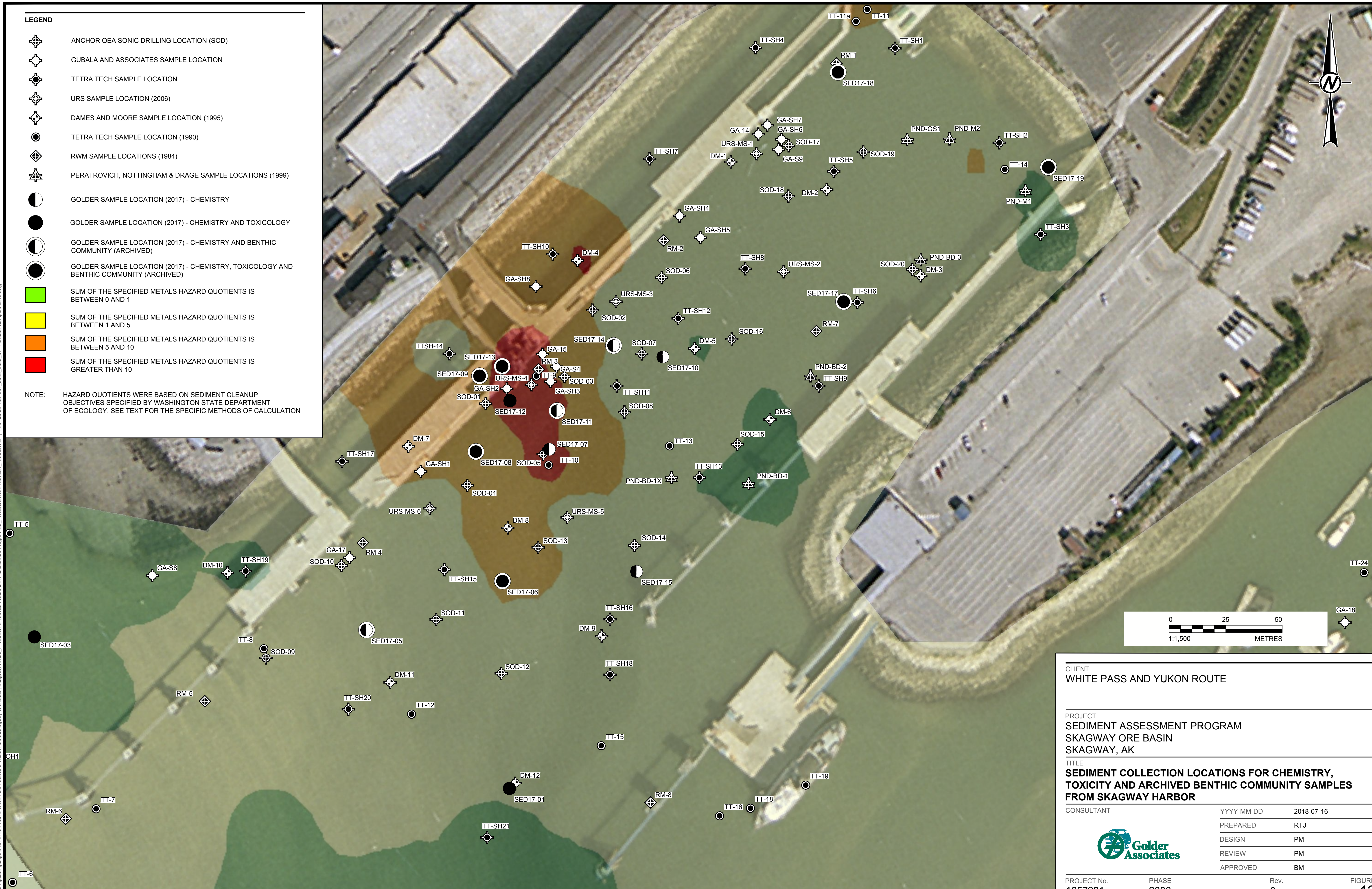
Figure 11: Spatial Distribution of Lead Concentrations along the Ore Dock and into the Ore Basin (view looking east)

Overall, there appears to be a pattern that elevated concentrations of the metals of concern are limited to the shallow and mid-level samples collected primarily near the ore-loader, to a maximum depth of approximately 7.7 feet below mudline.

At least one individual PAH parameter was detected in 13 of the 14 shallow and middle sediment samples submitted for PAH analysis. Most samples had multiple PAHs detected. None of the samples exceeded the total LPAH criteria defined by the WDOE. For total HPAH, there were seven samples that exceeded the SCO guideline. The primary HPAH parameters included Benzo(a)anthracene, benzo(b,j,k)fluoranthrene, fluoranthrene, and pyrene. Previous coring investigations in the Ore basin have measured HPAH concentrations at over 1,200 mg/kg. There are high HPAH concentrations located near the Ore loader and in various locations throughout the Ore Basin. The source of hydrocarbons in the Ore Basin is not known.

Golder also submitted core samples for coprostanol, cholestenol, total and faecal coliforms due to the results of the shallow sediment testing results that indicated that some of the data may have been impacted by the presence of faecal matter. Total coliforms were recorded in 7 of the 13 core samples submitted for analysis. The samples with detected total coliforms were collected from the shallow and medium depths at locations that appear likely to have receiving inputs from the municipal outfall (SED17-32, -33, -37, -38) and from SED17-41.

Cholestanol is a by-product of mammalian gut metabolism similar to coprostanol. Cholestanol was detected in four of the twelve samples submitted for analysis. As noted in the risk assessment report, there are multiple factors that can influence the quantified concentrations of these types of indicators. The purpose of including these indicators in the core sampling was to provide analysis that were not biased by an extended hold time. As with the surficial sampling, the presence of detected concentrations of the substances are simply a qualitative indictor that sewage inputs may be influencing sediment quality.



LEGEND

- ANCHOR QEA SONIC DRILLING LOCATION (SOD)
- GUBALA AND ASSOCIATES SAMPLE LOCATION
- TETRA TECH SAMPLE LOCATION
- URS SAMPLE LOCATION (2006)
- DAMES AND MOORE SAMPLE LOCATION (1995)
- TETRA TECH SAMPLE LOCATION (1990)
- RWM SAMPLE LOCATIONS (1984)
- PERATROVICH, NOTTINGHAM & DRAGE SAMPLE LOCATIONS (1999)
- GOLDER SAMPLE LOCATION (2017) - CHEMISTRY
- GOLDER SAMPLE LOCATION (2017) - CHEMISTRY AND TOXICOLOGY
- GOLDER SAMPLE LOCATION (2017) - CHEMISTRY AND BENTHIC COMMUNITY (ARCHIVED)
- GOLDER SAMPLE LOCATION (2017) - CHEMISTRY, TOXICOLOGY AND BENTHIC COMMUNITY (ARCHIVED)
- SUM OF THE SPECIFIED METALS HAZARD QUOTIENTS IS BETWEEN 0 AND 1
- SUM OF THE SPECIFIED METALS HAZARD QUOTIENTS IS BETWEEN 1 AND 5
- SUM OF THE SPECIFIED METALS HAZARD QUOTIENTS IS BETWEEN 5 AND 10
- SUM OF THE SPECIFIED METALS HAZARD QUOTIENTS IS GREATER THAN 10

NOTE: HAZARD QUOTIENTS WERE BASED ON SEDIMENT CLEANUP OBJECTIVES SPECIFIED BY WASHINGTON STATE DEPARTMENT OF ECOLOGY. SEE TEXT FOR THE SPECIFIC METHODS OF CALCULATION

CLIENT
WHITE PASS AND YUKON ROUTE

PROJECT
SEDIMENT ASSESSMENT PROGRAM
SKAGWAY ORE BASIN
SKAGWAY, AK

TITLE
SEDIMENT COLLECTION LOCATIONS FOR CHEMISTRY, TOXICITY AND ARCHIVED BENTHIC COMMUNITY SAMPLES FROM SKAGWAY HARBOR

CONSULTANT

Golder Associates

YYYY-MM-DD	2018-07-16
PREPARED	RTJ
DESIGN	PM
REVIEW	PM
APPROVED	BM

PROJECT No.	PHASE	Rev.	FIGURE
1657231	2000	0	12

25 mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

LEGEND

- REFERENCE SAMPLE LOCATION (2008)
- REFERENCE SAMPLE LOCATION (2007)
- PND REFERENCE SAMPLE LOCATION (1999)
- TETRA TECH REFERENCE SAMPLE LOCATION (1990)
- ANCHOR QEA SONIC DRILLING LOCATION (SOD)
- GUBALA AND ASSOCIATES SAMPLE LOCATION
- TETRA TECH SAMPLE LOCATION
- URS SAMPLE LOCATION (2006)
- DAMES AND MOORE SAMPLE LOCATION (1995)
- TETRA TECH SAMPLE LOCATION (1990)
- RWM SAMPLE LOCATIONS (1984)
- GOLDER SAMPLE LOCATION (2017) - CHEMISTRY
- GOLDER SAMPLE LOCATION (2017) - CHEMISTRY AND TOXICOLOGY
- GOLDER SAMPLE LOCATION (2017) - CHEMISTRY AND BENTHIC COMMUNITY (ARCHIVED)
- GOLDER SAMPLE LOCATION (2017) - CHEMISTRY, TOXICOLOGY AND BENTHIC COMMUNITY (ARCHIVED)

REFERENCE

BASE IMAGERY PROVIDED BY ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

0 500 1,000

1:20,000 METRES

CLIENT

WHITE PASS AND YUKON ROUTE

PROJECT

SEDIMENT ASSESSMENT PROGRAM
SKAGWAY ORE BASIN
SKAGWAY, AK

TITLE

SEDIMENT COLLECTION LOCATIONS FOR CHEMISTRY, TOXICITY AND ARCHIVED BENTHIC COMMUNITY SAMPLES FROM REFERENCE AREAS

CONSULTANT

Golder Associates

YYYY-MM-DD	2018-07-16
PREPARED	RTJ
DESIGN	PM
REVIEW	PM
APPROVED	BM

PROJECT No.	PHASE	Rev.	FIGURE
1657231	2000	0	13

Path: \\golder.gds\gal\Fort St John\CAD-GIS\White Pass and Yukon Route\Skagway Ore Basin, Skagway AK\99_PROJECTS\1657231 Sediment Assessment Program\02_PRODUCTION\1657231_10502\DWG\ | File Name: 1657231_2000_2002_02 - Bay Samples 2018.dwg

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

LEGEND

- CRAB TISSUE SAMPLE LOCATION
- PRAWN TISSUE SAMPLE LOCATION
- CRAB AND PRAWN TISSUE SAMPLE LOCATION
- MUSSEL TISSUE COLLECTION AREA

REFERENCE

BASE IMAGERY PROVIDED BY ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

0 100 200
1:4,000 (DETAIL) METRES

0 500 1,000
1:20,000 METRES

CLIENT
WHITE PASS AND YUKON ROUTE

PROJECT
SEDIMENT ASSESSMENT PROGRAM
SKAGWAY ORE BASIN
SKAGWAY, AK

TITLE
TISSUE COLLECTION LOCATIONS DURING GOLDER 2017 SAMPLING PROGRAM

CONSULTANT

Golder Associates

YYYY-MM-DD	2018-07-16
PREPARED	RTJ
DESIGN	PM
REVIEW	PM
APPROVED	BM

PROJECT No.	PHASE	Rev.	FIGURE
1657231	2000	0	14

25 mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Path: \\golder.gds\gal\Fort St John\CAD-GIS\White Pass and Yukon Route\Skagway Ore Basin, Skagway AK\99_PROJECTS\1657231\Sediment Assessment Program\02_PRODUCTION\1657231_10502\DWG\ | File Name: 1657231_2000_2002_03 - Tissue Sample 2018.dwg

4.0 RISK ASSESSMENT IMPLICATIONS

4.1 Objective and General Approach

The general approach of this section is to discuss how different types of information collected from the site help to inform risk management decisions. This evaluation focuses on the data collected by Golder in 2017, with reference to historical data where appropriate. Each of the different types of data (e.g., sediment chemistry, toxicity, bioaccumulation data) provides a different line of evidence that support an overall conclusion about the magnitude of risk associated with ore-related sediment contamination. The integration of those different lines of evidence uses weight-of-evidence approaches from the literature (Chapman et al. 1997; Chapman and Anderson 2007; USEPA 2016). In practical terms, the different lines of evidence involve consideration of the following questions as part of the risk assessment:

- Sediment chemistry
  - How much are benthic organisms exposed to ore-related metals in sediment? Do the total metal concentrations in sediment have the potential to cause adverse effects to benthic organisms?
  - Are there other substances present in sediment that could also contribute to adverse effects that are not related to the ore concentrates?
  - Is it likely that the total metals in sediment are bioavailable to benthic organisms via porewater?
  - Are the patterns in the chemistry data consistent with the discussion in the conceptual site model that metals in sediment originate from ore concentrates deposited from historical operation of the ore loading facility? Does the pattern make sense in light of the sediment transport analysis?
- Toxicity
  - Are there effects to test organisms exposed to field-collected samples using standardized, laboratory-based toxicity tests?
  - Is there evidence that effects (if present) are the result of metals in sediment?
- Bioaccumulation
  - Are ore-related metals accumulating in shellfish at concentrations that are higher than in other parts of Skagway Harbor or reference areas?
  - Are there any patterns in tissue concentrations over space or time that indicates that the ore concentrates are the likely source of the elevated metals in tissues?
  - Are there other substances that are also present in shellfish tissues?
  - Do the observed concentrations indicate that further work needs to be done to evaluate whether or not wildlife or humans are being exposed to hazardous concentrations?

4.2 Sediment Chemistry

Bulk sediment chemistry (e.g., the total concentration of lead, zinc or other substances in sediment) is an important line of evidence in a sediment risk assessment because it provides information about the magnitude of the hazard associated with different substances in sediment (i.e., it can be readily compared to conservative screening values established by regulatory agencies). However, an exceedance of a screening value does not mean that a risk is present.

4.2.1 Selection of Screening Values

Many jurisdictions establish screening values from a statistical analysis of co-located chemistry and effects data. There are multiple methodologies for deriving empirically-based screening values[24]. The selected screening values for the current assessment were from Washington Department of Ecology (WDOE 2015) who used the apparent effect threshold approach to derive sediment cleanup objectives (SCO) and contaminant screening limit (CSL) values.

In brief, SCOs and CSLs are derived for each individual substance of interest by examining a database of co-located effects and chemistry data (Barrick et al 1988). Barrick et al. (1988) determined the highest concentration that corresponded to a “no effect” level for four different types of data[25]. The SCO was set to the lowest of the apparent effect thresholds, and the CSL was set to the second-lowest of the apparent effect thresholds (WDOE 2015). For most of the ore-related metals, the lowest apparent effect threshold from Barrick et al. (1998) was based on the benthic abundance data.

Golder understands ADEC is in general agreement that Washington Department of Ecology (WDOE) Sediment Management Standards provide a reasonable basis for showing compliance with Alaska Regulation 18 AAC 75.340(i)(2)(B). WDOE (2015). SCO and CSL values were approved for use in the current assessment by ADEC (Table 2).

[24] ADEC (2001) provides an overview of theoretical and empirical (i.e., derived from databases of co-located samples) approaches for deriving sediment guidelines and discusses their applicability to Alaskan sites.

[25] The Barrick et al. (1988) data set is based on n = 50 for Microtox, n = 50 for oyster larval development, n = 201 for benthic abundance and n = 287 for amphipod survival. The decision point (i.e., is there an effect?) is whether a sample demonstrated a statistically significant difference ($p > 0.05$) relative to reference.

Table 2: Summary Sediment Screening Values Used in the Risk Assessment

Parameter		WDOE Sediment Cleanup Objective	WDOE Cleanup Screening Level
Metals	Arsenic	57 mg/kg	93 mg/kg
	Cadmium	5.1 mg/kg	6.7 mg/kg
	Copper	390 mg/kg	390 mg/kg
	Chromium	260 mg/kg	270 mg/kg
	Lead	450 mg/kg	530 mg/kg
	Mercury	0.41 mg/kg	0.59 mg/kg
	Silver	6.1 mg/kg	6.1 mg/kg
	Zinc	410 mg/kg	960 mg/kg
Polycyclic Aromatic Hydrocarbons	2-Methylnaphthalene	670 µg/kg	670 µg/kg
	Acenaphthene	500 µg/kg	500 µg/kg
	Acenaphthylene	1300 µg/kg	1300 µg/kg
	Anthracene	960 µg/kg	960 µg/kg
	Benzo(a)anthracene	1300 µg/kg	1600 µg/kg
	Benzo(a)pyrene	1600 µg/kg	1600 µg/kg
	Benzo(g,h,i)perylene	670 µg/kg	720 µg/kg
	Chrysene	1400 µg/kg	2800 µg/kg
	Dibenz(a,h)anthracene	230 µg/kg	230 µg/kg
	Fluoranthene	1700 µg/kg	2500 µg/kg
	Fluorene	540 µg/kg	540 µg/kg
	Indeno(1,2,3-cd)pyrene	600 µg/kg	690 µg/kg
	Naphthalene	2100 µg/kg	2100 µg/kg
	Phenanthrene	1500 µg/kg	1500 µg/kg
	Pyrene	2600 µg/kg	3300 µg/kg

4.2.2 Physical Characteristics

Grain size and total organic carbon concentrations for surficial samples collected in the current assessment are provided in Table A1 of the field data report (Appendix C). Samples collected from the Site were generally dominated by sands and silt with some gravels and shells. There was a relatively wide range of particle size distributions amongst stations in the same area. For example, percent fines ranged from 11 to 86% among the ore basin stations, from 65 to 72% among the stations elsewhere in Skagway Harbour, and from 35 to 89% among the reference stations. Total organic carbon concentrations ranged from <0.23 to 1.1% among the ore basin stations, from 0.8 to 1.4% among the stations elsewhere in Skagway Harbour, and from <0.25 to 2.41% among the reference stations.

4.2.3 Bulk Chemistry Data

Ore-Related Contaminants of Concern

The primary contaminants related to ore concentrates were lead, zinc and copper. Other metals such as arsenic, cadmium, mercury and silver were also considered likely to be related to ore concentrates based on historical information (see Section 2.2.1). Table A of the field data report (Appendix C) provides a comparison of metal concentrations in surficial sediment collected from the site to the WDOE (2015) SCO and CSL screening values. Figure 15 provides an overview of ore-related metal concentrations[26], and shows that:

- Most samples from within the Ore Basin did not have concentrations of ore-related metals that exceeded the SCO screening value. A total of four stations (SED17-08, SED17-09, SED17-12 and SED17-13) contained concentrations of at least one metal that was higher than the SCO. There were no exceedances observed in samples collected from outside the Ore Basin or from reference areas.
- The maximum concentrations of metals in the collected Zone A samples were lower than those observed in the historical data from the same area, which is consistent with the conclusion from the sediment transport analysis that cleaner fine-grained material is being deposited over time.
- There appears to be a visual pattern where lead, zinc and mercury concentrations were highest from sample locations near the ore loading conveyor belt (Zone A) which is consistent with the release mechanism described in Section 2.2.4.

Hydrocarbons

Hydrocarbons were identified as an additional contaminant of concern that could influence sediment quality. All surficial sediment samples were analyzed for polycyclic aromatic hydrocarbons to facilitate evaluation of this contaminant group against SCO and CSL screening values. A subset of samples was also analyzed for diesel range and residual range organics (DRO and RRO) for consistency with state risk assessment practices. DRO and RRO provide complementary information to the measurement of polycyclic aromatic hydrocarbons. DRO and RRO do not have sediment screening values, and are not typically considered to be of toxicological concern (i.e., they do not tend to partition into pore water where they can be accumulated by benthic organisms). Rather, DRO and RRO provide information about how extractable petroleum hydrocarbons could influence the physical structure of sediment. The relative proportions of DRO and RRO also help to identify likely sources of the hydrocarbons. PAH, DRO and RRO data are summarized in Table A1 of the field data report in Appendix C. In brief:

- Nearly all stations have detectable concentrations of one or more PAHs, including reference stations at Nakhu Bay. PAH concentrations were less than detection limits at the other reference stations. PAHs are ubiquitous in urbanized harbours and the presence of PAHs in all samples collected from the Ore Basin or other areas of Skagway Harbor is unsurprising.

[26] Gold is not routinely measured in total metals analysis. SCO and CSL screening values are not available.

- Although PAHs were present in all samples, they were rarely present at concentrations that exceeded the SCO or CSL screening values. Only two locations exceeded the SCO screening limits for PAHs. Station SED17-13 and SED17-09 exceeded the SCO for total high molecular weight PAHs. Both of these locations are within the Ore Basin near pilings of the ore dock.
- Broadly, there were no exceedances of low molecular weight PAHs such as naphthalene in the sediment. Exceedances were limited to high molecular weight PAHs and the majority of the exceedances of the total high molecular weight hydrocarbon SCO was from benzo(a)anthracene, chrysene, fluoranthene and pyrene. These individual PAHs are often associated with the weathering of creosote from preserved timbers (USDA 2004). Concentrations of DRO and RRO were less than detection limits in most samples collected from the Ore Basin or other parts of Skagway Harbor and were within 3x detection limits for DRO in the two samples with exceedances of the SCO for one or more PAHs. The low concentrations of DRO suggest that diesel fuel is not the primary source of the PAHs. PAH fingerprinting to provide a definitive identification of source beyond this qualitative assessment has not been completed.

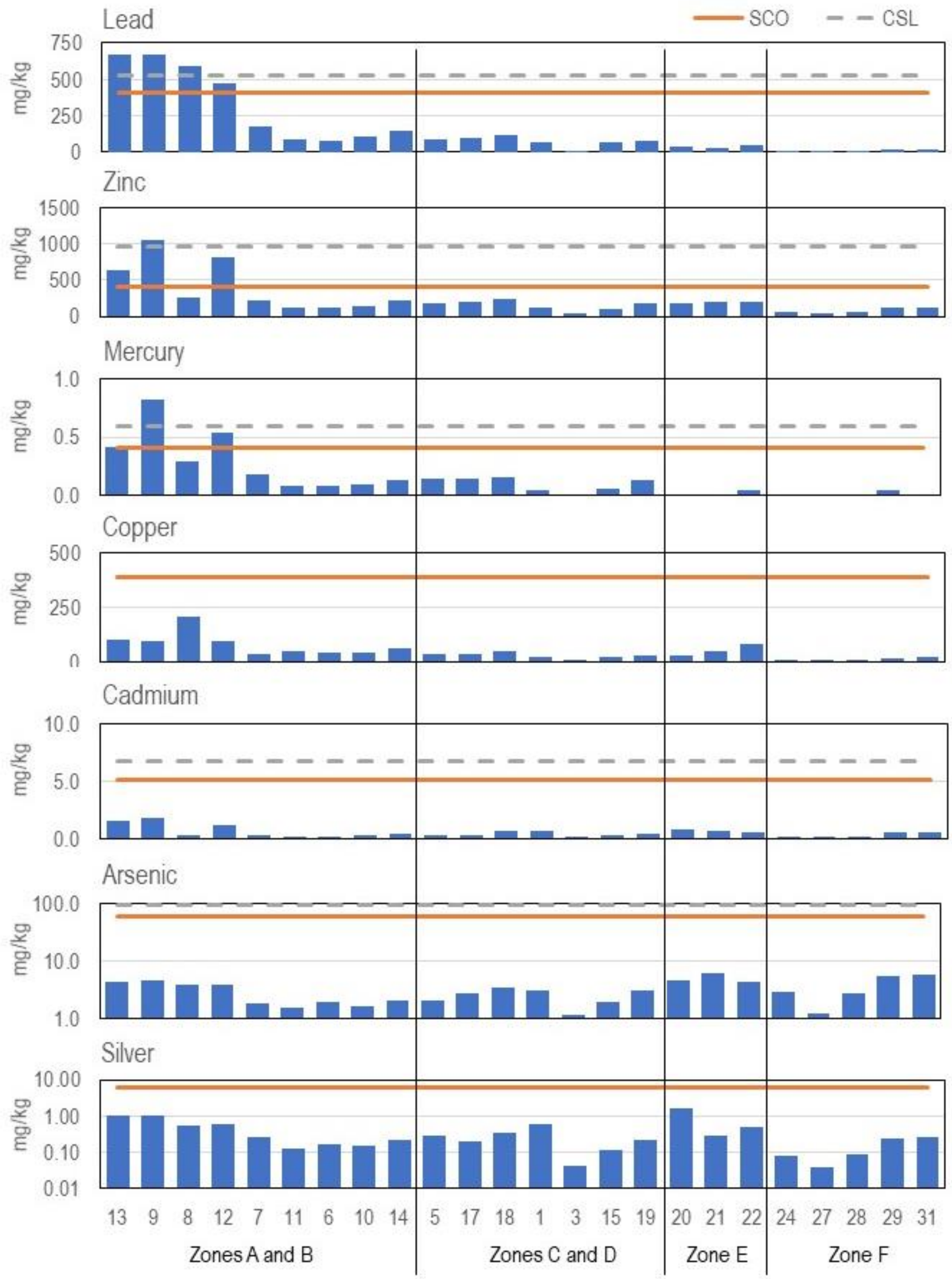


Figure 15: Concentrations of ore-related metals in surficial sediment samples

Wastewater Indicators

Municipal and cruise ship discharges were not originally considered as a potential source of contaminants in the development of the sampling and analysis plan (Appendix B). However, information obtained during the toxicity identification evaluation (Section 4.4) indicated that ammonia was contributing to the observed sediment toxicity. Ammonia is naturally present in fine-grained, organic-rich material and is typically treated as a confounding factor in sediment toxicity testing. However, ammonia is also a regulated substance in wastewater discharges, and several sources of wastewater have been identified (which includes the presence of approved mixing zones within the Skagway Basin).

Golder submitted archive sediment samples from the May 2017 surface grab sampling for coprostanol analysis. Coprostanol is a sterol produced by metabolic activity in the guts of humans, birds and some other higher-level mammals; it is frequently used as a bio-indicator of sewage discharges. Coprostanol is relatively stable under anaerobic (low oxygen conditions), but biodegrades in oxygenated sediment (Pratt et al. 2008). A total of 10 samples were submitted for coprostanol analysis to provide a semi-quantitative indicator of whether sewage inputs could be influencing sediment quality. Samples were collected in early May prior to the arrival of cruise ships. Samples were also submitted more than 90 days after their original collection dates (because ammonia was not identified as a potential issue until after the first round of the toxicity identification evaluation). Both these factors would tend to bias the coprostanol concentrations downwards.

A summary of the coprostanol data is provided in Appendix E-1. Concentrations were less than detection limits in six of the 10 samples. As noted above, the absence of detected coprostanol is not definitive evidence that sewage inputs are not occurring because of the likelihood that the data are biased downward. Coprostanol concentrations ranged from 0.075 to 0.355 mg/kg in the remaining four samples. The sample with the highest coprostanol concentration (SED17-01) was also the sample closest to the municipal outfall. The next two concentrations (SED17-13 and SED17-18) are located in the Ore Basin in areas with the greatest accumulation of fine-grained material, while the fourth sample with a detected concentration (SED17-05) is also closer to the municipal outfall. There are no numerical sediment quality guidelines for coprostanol, but even if there were, it would not be appropriate to make a quantitative comparison because of the limitations associated with the data. However, the data are sufficient to conclude that sewage inputs may be a factor that can influence the toxicity data, based on the pattern in the data distribution noted above.

Golder also submitted core samples for coprostanol, cholestenol, total and fecal coliforms. Data are summarized in Appendix D, but overall, total coliforms were recorded in seven of the 13 core samples submitted for analysis. The samples with detected total coliforms were collected from the shallow and medium depths at locations that appear likely to receive inputs from the municipal outfall (SED17-32, -33, -37, -38) based on their locations. Cholestanol is another byproduct of mammalian gut metabolism similar to coprostanol and was detected in four of the 13 samples submitted for analysis.

The presence of detected concentrations of these substances are simply a qualitative indictor that sewage inputs may be influencing sediment quality but is not intended as a diagnostic evaluation of relative contributions. It is not known whether these substances reflect anthropogenic sources, or are being influenced by other wildlife. No attribution with respect to source can be made from this qualitative information.

4.2.4 Assessment of Potential Bioavailability of Selected Metals

Simultaneously extracted metals (SEM) and acid volatile sulphide (AVS) analyses were conducted in a subset of sediment samples collected in 2017 to support the toxicity testing. Measurements were conducted within the recommended holding time for sediment analysis. AVS-SEM is a calculation used to predict when toxicity is unlikely to occur as result of specific metal ions. AVS binds with the metal ions in porewater (the primary route of exposure for benthic organisms) in a predictable sequence (Hg > Cd > Pb > Cd > Zn > Ni). Metal ions that are bound to sulfides form an insoluble precipitate that has limited bioavailability. An excess of sulphides in a sample means that those metal ions are unlikely to be bioavailable and therefore are unlikely to cause toxicity.

AVS-SEM data are summarized in Table A1 of the field data report (Appendix C), and shown below in graphical form in Figure 16. The concentrations of AVS ranged from <0.037 to 8.39 µmol/g among the Skagway Harbour stations and from 0.057 to 2.7 µmol/g among the reference stations. These values are low relative to other urbanized harbour locations evaluated by the authors, especially given the relative high percentages of fines present in the samples. Most of the fine-grained material in the samples was classified as clay which is presumably part of the sediment inputs from the Skagway River. The sum of the SEM concentrations ranged from 0.19 to 3.1 µmol/g among the Skagway Harbor stations and from 0.094 to 0.56 µmol/g among the reference stations. Observations based on the available AVS-SEM data

- The majority of extractable metals consisted of lead or zinc. Copper, arsenic, mercury and silver had minimal SEM. This is consistent with how ore concentrate has been released to sediment (i.e., the majority of the mass of metals associated with ore concentrate loadings is expected to be lead, followed by zinc).
- Samples tended to have low AVS concentrations, and those concentrations were often unlikely to sorb all the lead or zinc that has the potential to dissociate from the ore concentrate. However, sufficient AVS was present in the samples with the worst-case total metal concentrations that also had demonstrated adverse effects to amphipods. This observation indicates that metals may not be the cause of the adverse effects in those specific samples.

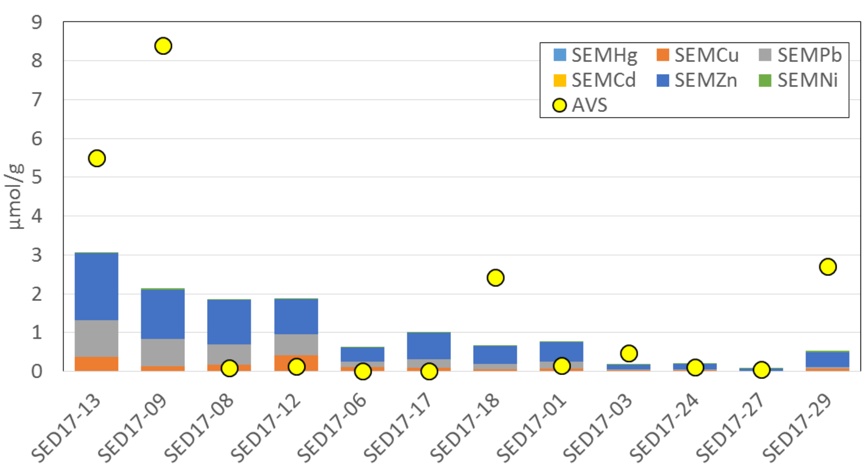


Figure 16: Concentrations of Simultaneously Extracted Metals (SEM) versus the Concentrations of Acid Volatile Sulphide (AVS) in the Sediment Samples Collected for the 2017 Field Investigation.

4.2.5 Principal Components Analyses

Principal component analysis (PCA) was applied to the sediment chemistry to examine the underlying patterns in how different substances are distributed. PCA is a technique that reduces a number of possibly related variables (for example, the concentrations of different ore-related metals) to one or two components. These key components from the original data matrix reduce the multi-dimensional nature of the data while retaining as much of the information from the original variables as possible. PCAs were calculated using Systat™ (Version 13) using $\log_{10}$ transformed data for:

- Metals concentrations for the surficial samples.
- Metals concentrations for both the surficial samples and the core sampling.

Log10 transformed data was used because the resulting PC1 and PC2 was able to incorporate more of the underlying variability than using non-transformed data. Environmental chemistry data collected from non-random locations selected to capture the range of concentrations but with increased emphasis on the worst-case areas would generally be expected to have a log normal distribution rather than a normal distribution. Variables were excluded from statistical analyses if they were undetected at more than 50% of all stations (i.e., not 50% of the stations within an individual zone). Concentrations reported as undetected were converted to their detection limit (DL) prior to analysis. Spearman rank correlations (r_s) were then calculated between the principal components and exposure variables, to identify variables that were most (or least) closely associated with the exposure variables. Statistical outputs are provided in Appendix E-2, and observations based on the PCA are summarized below.

- For surficial metals:
  - The first principal component (MetalsPC1) accounted for 67% of the total variability in the metals chemistry data. There were no statistically significant correlations with the primary metals associated with ore concentrates (lead, zinc, copper; also mercury), and the range of MetalsPC1 values overlapped with the five reference areas (Figure 13). Golder concluded that this principal component likely represents clean sediment inputs from the Skagway River.
  - The influence of the ore concentrate can be seen in MetalsPC2. All three of the metals that had exceedances of the SCO screening values (lead, zinc and mercury) had statistically significant correlations to MetalsPC2. Copper also had a statistically significant correlation. MetalsPC2 explains a further 18% of the total variability in the metals chemistry data.
  - In terms of the relative influence of the two sources, the “clean inputs” source was dominant for the majority of samples from the Ore Basin. The “ore concentrate” source is apparent in four of the locations (SED17-08, -09, -12 and -13) (Figure 16), and all four of these locations are near the ore conveyor belt.

- For all surface and core samples collected by Golder:
  - The pattern in the chemistry data changed because of the inclusion of a relatively large number of deeper samples that were likely more strongly influenced by the presence of ore concentrates. Instead of two distinct MetalsPCs that could be attributed to different influences, the PCA found that all metals were correlated with the first principal component, which accounted for 62% of the total variance.
  - There are groups of samples that show a distinct difference in the “intensity” of metal contamination (i.e., much higher MetalsPC1 scores). These stations include Station 34, 35, 36 and 37.
- For PAHs, more than 94% of the total variance in chemistry concentrations was captured in the first principal component. This suggests that there is a common source of hydrocarbons (i.e., there was no evidence that some samples were influenced by gasoline sources while other samples were influenced by creosote). The specific nature of the source has not been confirmed, but could be the use of creosote preservatives based on observations about the type of PAHs that were present (Section 4.2.3).

Based on the PCA, Golder concluded that there was evidence of a cleaner source of sediment being deposited onto the Ore Basin. The surface sediment samples (i.e., the biological active layer that was sampled for toxicity testing and would be the habitat occupied by benthic organisms) showed a gradient that can be attributed to ore concentrates that is being gradually masked by the cleaner material. Deeper contamination along the ore dock is different than the surficial material, and shows a distinct area where the PCA fingerprint differs from the patterns observed in the shallow samples.

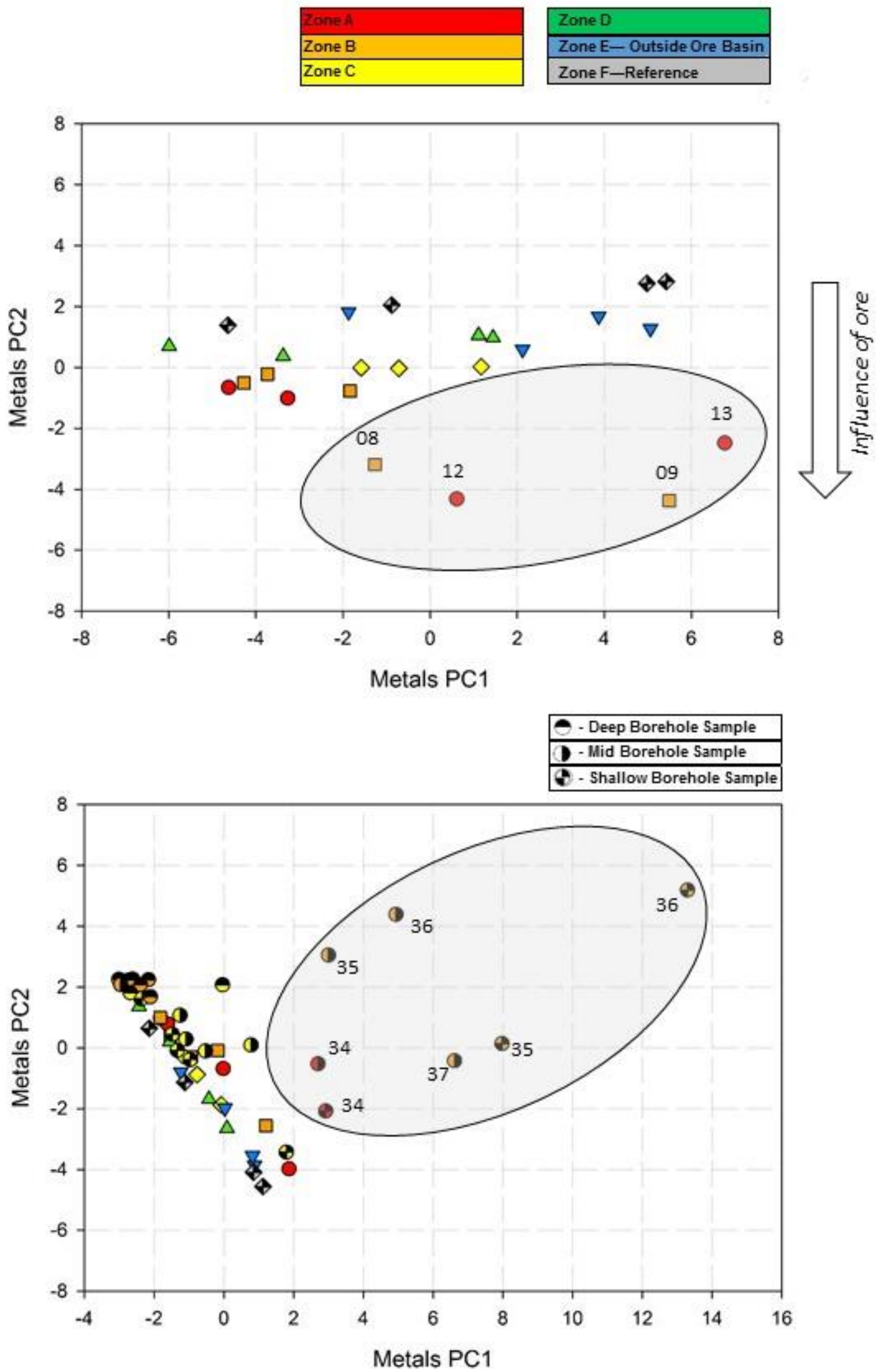


Figure 17: Principal component analysis for metals (surface samples – top; all samples – bottom)

4.3 Sediment Toxicity

Sediment toxicity testing was conducted on a subset of 14 stations selected to be representative of the range of metal and PAHs concentrations found in surface samples. Sediment toxicity testing provides a standardized measure of the potential effects associated with a field-collected sample. The following toxicity tests were selected following WDOE (2015) guidance:

- 96-h sea urchin *Strongylocentrotus purpuratus* larval survival and development (normal survival).
- 10-d amphipod *Eohaustorius estuarius* survival.
- 20-d marine *polycheate Neanthes arenceadentata* survival and growth.

These tests measure lethal and sublethal effects of sediment on representative benthic and epibenthic organisms. The different species have a variety of different exposure mechanisms. Sea urchin larvae are exposed through a sediment elutriate (i.e., a mixture of sediment and overlying sea water). Amphipods are exposed though direct contact with sediment and sediment porewater. Polychaetes are exposed through direct contact with sediment porewater and through ingestion of sediment particles.

4.3.1 Decision Framework

Data were evaluated against the decision criteria described by WDOE (2015). WDOE (2015) establishes SCO and CSL benchmarks based on toxicological performance[27], as follows:

- Sea urchin normal survival – The test fails to meet the SCO benchmark in a sample if the normal survival is reduced by more than 15% relative to the reference sample and that difference is statistically significant. The test fails to meet the CSL benchmark in a sample if the normal survival is reduced by more than 30% relative to the reference sample and that difference is statistically significant.
- Amphipod survival – The sample test fails to meet the SCO benchmark in a sample if survival is less than 75% and the result is statistically different than the reference sample. The test fails to meet the CSL benchmark in a sample if survival was reduced by more than 30% relative to the reference and that difference is statistically significant.
- Polychaete growth – The sample test fails to meet the SCO benchmark in a sample if growth was reduced by more than 30% relative to the reference and that difference is statistically significant. The test fails to meet the CSL benchmark in a sample if growth was reduced by more than 50% relative to the reference and that difference is statistically significant.

[27] The following bullets provide a plain-language summary of the decision criteria. See Table 8-2 of WDOE (2015) for the specific formulae used. Note that statistical significance is based on $p > 0.05$ for all test except sea urchin normal survival which is based on a $p > 0.10$.

- Overall status – A final decision about the status of the sample is based on consideration of all three test benchmarks. A sample fails to meet the SCO if any of the three tests fail to meet their respective SCO benchmark. A sample fails to meet the CSL if any of the three tests fail to meet their respective CSL benchmark, or if two of the test fail to meet their SCO benchmarks.

Identification of an appropriate reference station is a key aspect of evaluating toxicity data using the WDOE (2015) approach. Three different reference samples were selected for toxicity testing from the five samples collected. One sample was selected from each of the three reference areas, and where multiple samples for a single reference area was available, samples were selected to provide the best match in terms of grain size and organic carbon content relative to the samples from the Ore Basin. The three reference samples assessed in the toxicity testing program were:

- SED17-24 (Dyea Point). This was the only sample collected from this reference area.
- SED17-27 (Taiya River). This sample was selected instead of SED17-28 because it had a lower percentage of fines which was closer to the typical percent fines in the Ore Basin samples. This reference sample also had little to no organic carbon, which was consistent with many samples from the Ore Basin.
- SED17-29 (Nahku Bay). This sample was selected instead of SED17-31 to provide an upper-case bound of the influence of organic carbon and percent fines. This sample had the highest organic carbon of all samples assessed (2.4%) which was higher than the range of organic carbon values observed in the Ore Basin. This sample also had percent fines (86.3%) which was higher than most of the samples collected from the Ore Basin.

All three reference samples were evaluated against the decision criteria established by WDOE (2015) for selection of reference samples[28]. All reference samples met their test-specific decision criteria with the exception of SED17-29 for sea urchin normal survival and amphipod survival. Samples collected from the Ore Basin were compared to the average performance of the valid reference samples.

4.3.2 Summary of Results

Tabular summaries with the performance of individual samples can be found in Section 3.2 of the field data report (Appendix C). The original report from the subcontractor laboratory is also included in Appendix C. Toxicity data are summarized below in Figure 18 with test-specific and overall classification of each sample.

[28] See Table 8-2 of WDOE (2015). Validation of a reference sample involves comparison to the laboratory negative control. A valid reference cannot be reduced by more than the limits established by WDOE (2015).

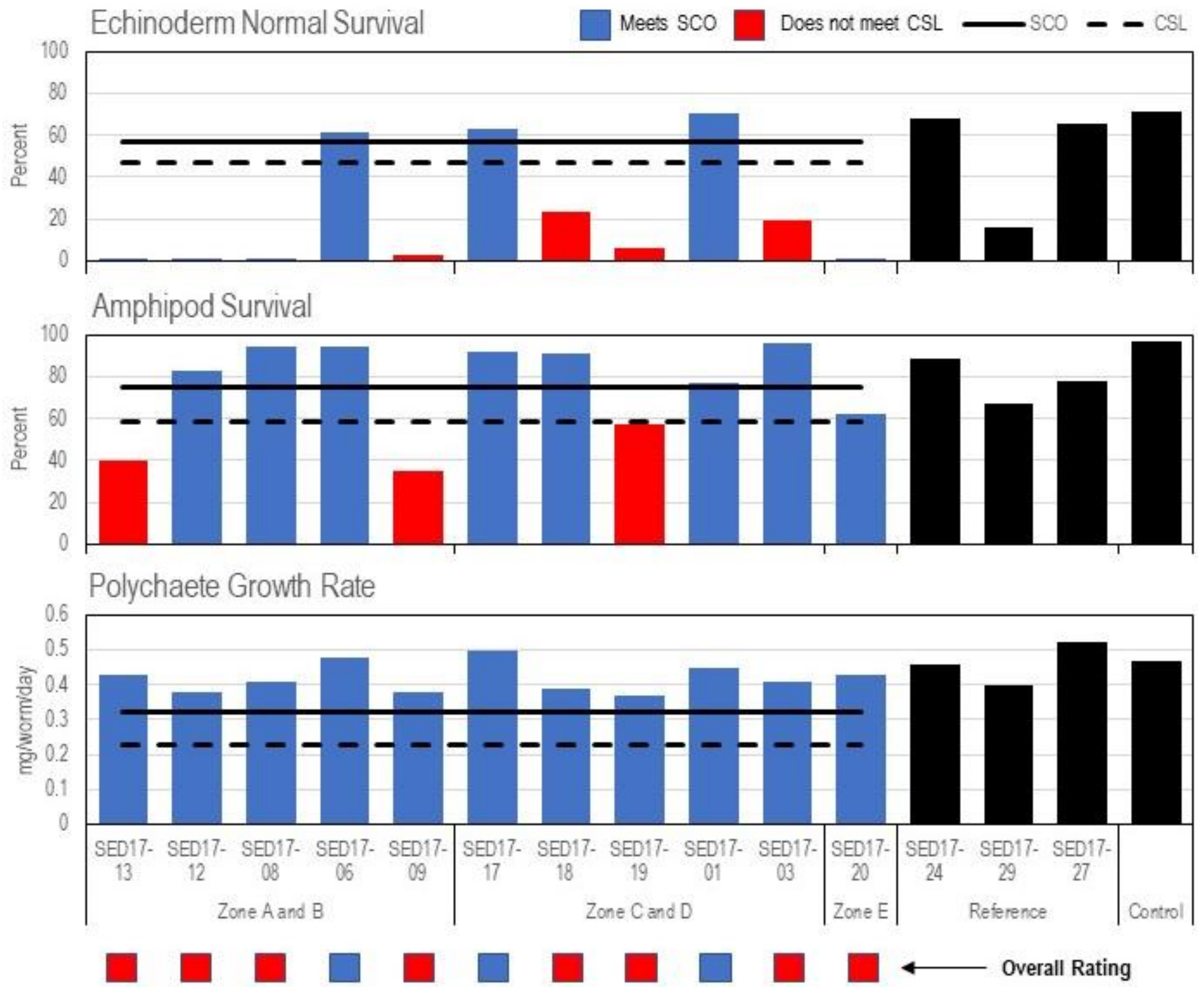


Figure 18: Summary of sediment toxicity test performance

Overall, most samples collected from the Ore Basin failed to meet the WDOE (2015) biological CSL criteria. Only three samples had adequate performance in all three toxicological endpoints to meet the SCO biological criteria. All remaining samples failed to meet the CSL biological criteria in at least one of the three toxicity tests, even though only four of those samples (SED17-08, SED17-09, SED17-12 and SED17-13) had concentrations that exceeded numerical standards for chemistry. This observation indicated that sample toxicity may be influenced by factors other than metals or hydrocarbons. Potential hypotheses that were identified at the completion of the sediment toxicity testing included:

- Metals may be exerting an effect in toxicity testing that is substantially larger than what would be expected based on the total metals concentrations. Although the chemistry-based SCO and CSL screening limits are conservative, it is possible that the leaching of metals from ore concentrate is behaving in an unexpected way that leads to much higher concentrations of metals in porewater. Evidence for this hypothesis included the observation that there was limited AVS in many samples (Section 4.2.4).

- There may be natural concentrations of ammonia and sulfides present that are causing the observed toxicity. Ammonia and sulfide concentrations are measured during toxicity tests and the test methods specify ammonia and sulfide threshold limits to help determine when ammonia or sulfides are acting as a confounding factor.
- The physical characteristics of the sediment may create an additional type of confounding factor. Toxicity tests have been validated for the range of sediments that are typically found in urbanized harbours. Extreme deviations from the ranges of organic carbon and grain size distributions can cause anomalous effects in the toxicity test that are independent of effects caused by contaminants.
- There may be an unmeasured contaminant (or group of contaminants) that are present in sediment at concentrations capable of exerting adverse effects in the toxicity test.

SED17-09 and SED17-13 were selected for toxicity identification evaluation to help understand the likely cause of toxicity in the samples, and the available data was reviewed in greater detail to determine if sulfides, ammonia or physical characteristics were acting as a confounding factor in one or more of the samples.

4.3.3 Consideration of Sulfides as a Confounding Factor

Elevated concentrations of sulfide can naturally occur in sediment samples, and can confound the interpretation of toxicity tests by contributing to false positives. Sulfides tend to occur in organic-rich, low-oxygen sediments. Toxicity test methods specify when overlying or porewater samples should be collected during the course of the test, and have established threshold values for the test organisms which are used to determine when sulfides are likely contributing to the observed toxicity tests. Sulfide data were collected during the toxicity tests according to the requirements of the method, and are summarized in the toxicity laboratory certificates of analysis in Appendix C. In brief:

- Sulfide concentrations were measured in the overlying water of the 96-hr sea urchin larval development test at 0 and 96 hr. All concentrations were less than the analytical detection limit of 0.018 mg/L, and therefore, sulfides are not considered likely to be a confounding factor for this test.
- Sulfide concentrations were measured in the interstitial water of the 10-day amphipod survival test on Day 0 and Day 10. All concentrations were less than the analytical detection limit of 0.018 mg/L, except for SED17-08, which had a Day 0 concentration of 37.4 mg/L S. This concentration is substantially higher than the 48-h LC50 value obtained by Knezovich et al. (1996) for the test species. However, there was no reduction in survival for this specific sample, and therefore, sulfides are not expected to be a confounding factor for this test.
- Sulfide concentrations were measured in the interstitial water of the 20-day polychaete survival and growth test on Day 0[29] and Day 20. All concentrations were less than the analytical detection limit of 0.018 mg/L, with the exception of SED17-08 (Day 0 concentration of 37.4 mg/L S), and four samples which had Day 20

[29] Both tests were initiated on the same day. Only one set of Day 0 interstitial measurements were made, which apply to both tests.

concentrations of between 0.018 and 0.049 mg/L S. The measured sulfide concentration in SED17-08 interstitial porewater exceeded the no-observed effect threshold of 3.4 mg/L reiterated by Kendall and Barton (2004) based on Dillon et al. (1993). There were no reductions in polychaete growth or survival observed for this specific sample, and therefore, sulfides are not considered to be a confounding factor for this test.

4.3.4 Consideration of Ammonia as a Confounding Factor

Ammonia can also be present in marine sediment at concentrations that can act as a confounding factor in how toxicity test data are interpreted. Ammonia is generated from microbial degradation of organic material; it is a natural occurrence (and therefore, a confounding factor) when there is no anthropogenic loading of organic material. Ammonia data were collected during the toxicity tests according to the requirements of the method, and are summarized in the toxicity laboratory certificates of analysis in Appendix C. At the time that samples were tested by the toxicity laboratory, ammonia did not appear to be a confounding factor, based on the following comparison of ammonia data collected during the toxicity test to relevant screening values:

- Ammonia concentrations were measured in the overlying water of the 96-hr sea urchin larval development test at 0 and 96 hr. The total concentrations ranged from 0.07 to 0.33 mg/L total N in the 0 hr measurements, and from <0.01 to 0.31 mg/L total N in the 96 hr measurements. These values were converted to unionized ammonia based on sample-specific pH and temperature values recorded during the test. The unionized concentrations were consistently less than 0.005 mg/L unionized N, which is less than the generic threshold of 0.014 mg/L unionized N proposed by the test method. The measured concentrations were also substantially lower than the species-specific 96-h no-observed effect threshold of 0.06 mg/L unionized N reported by Greenstein et al. (1996). Ammonia is not considered to be a confounding factor in the initial sediment toxicity testing (but becomes an issue in the subsequent TIE testing as described in Section 4.4).

- Ammonia concentrations were measured in Day 0 and Day 10 overlying and interstitial waters for the 10-d amphipod survival test. Overlying water concentrations ranged from 0.12 to 1.48 mg/L total N on Day 0, and ranged from 0.06 to 6.89 mg/L total N on Day 10. Interstitial water concentrations ranged from 0.90 to 9.18 mg/L total N on Day 0, and from 0.84 to 13.1 mg/L total N on Day 10. Kohn et al. (1994) reported a species-specific 96-h LC50 of 125.5 mg/L total N. Barton (2002) concluded that ammonia was not likely to be a confounding factor for the interpretation of *E. estuarius* toxicity test for Washington State regulatory purposes provided that the interstitial concentrations were less than 60 mg/L total N. Therefore, the observed concentrations are not considered likely to be a significant confounding factor. The measured concentrations are substantially lower than the thresholds on a total ammonia basis, and therefore, conversion to unionized ammonia was not considered necessary.

- The Day 0 interstitial and overlying values for amphipods also apply to the 20-d polychaete survival and growth test. Day 20 overlying water concentrations for the polychaete test ranged from 0.57 to 5.4 mg/L total N, and Day 20 interstitial water concentrations ranged from 1.1 to 5.9 mg/L total N. Dillon et al. (1993) found a 21-d no observed effect threshold of 10 mg/L total N which was adopted by Kendall and Barton (2004) as the threshold value for this species when used for Washington State sediment programs. Therefore, the observed concentrations are not considered likely to be a significant confounding factor. The measured concentrations are substantially lower than the thresholds on a total ammonia basis, and therefore, conversion to unionized ammonia was not considered necessary.

4.3.5 Consideration of Grain Size as a Confounding Factor

Physical factors such as grain size or organic carbon content can also become a confounding factor if these variables fall outside the biological tolerances of the test species. The physical factors are not likely to be a confounding effect for the polychaete test because none of the samples demonstrated reductions relative to reference that failed the SCO or CSL biological criteria. Grain size was also considered unlikely to be a factor in the 96-h sea urchin larval development test because the test included a 24-h settling period to allow sediment to settle back out of the water column prior to the addition of the newly-fertilized sea urchin larvae.

However, several samples failed to meet the SCO biological criteria for the amphipod test, and therefore, further consideration was given to the biological tolerances for *Eohausatorius estuarius*. *E. estuarius* is a common amphipod used in routine toxicity testing, in part, because it is known to have a wide tolerance for both salinity and grain size. The species is suitable for grain size distributions ranging from 100% sand to >100% silts and clays, but Kendall and McMillan (1999) recommend that the clay content should not exceed 20%, based on anecdotal review that increased mortality of *E. estuarius* was noted in samples with high clay content. Clay content was 20% in SED17-19 which also demonstrated a marginal reduction below the CSL biological criteria. However, 20% is unlikely to be a biological limit. No specific data are provided by Kendall and McMillian (1999) to support the threshold proposed for Washington State toxicity testing. A literature review found examples where *E. estuarius* survival was acceptable in samples with high clay content (e.g., Anderson et al. 2004 found 76% survival in a field-collected sample with a 25% clay content). Tay et al. (1998) showed that survival of E. estuarius was only marginally reduced as the clay content increased to approximately 70%, and a clay content of 70% was adopted as the biological limit for this species by both Environment Canada (1998) and ASTM (2014). Golder concludes that clay content is unlikely to be a significant confounding factor in the interpretation of the toxicity data, although it is possible that there is a subtle relationship between amphipod survival and clay content at the upper range of the percentages found in site-specific samples in light of the observation from Kendall and McMillan (1999).

4.3.6 Correlation Analysis

Spearman rank correlations (r_s) were calculated to evaluate the relationship between the observed effects in the toxicity test and the underlying chemical variables. This included both individual contaminants of interest, as well as the principal components (which provide an integrated assessment of the underlying gradient of contamination).

Correlation analysis does not provide a definitive statement about cause and effect—it is simply a data exploration technique to look for statistically significant relationships that warrant further evaluation. Data exploration did not involve testing all possible correlations because there is always a small probability that one can find a statistically-significant correlation that is not actually present simply because the correlation analysis examined many possible combinations. Instead, the correlation analysis focused on testing specific combinations that were identified during the course of the investigation (e.g., does an increasing concentration of lead tend to result in increased effects on amphipod survival) that are relevant to site management.

As shown below in Table 3, none of the different toxicity test endpoints showed a statistically significant correlation to individual ore-related contaminants that exceeded the chemistry screening value in one or more samples, nor was there a statistical correlation to the underlying principal component that represented the ore-related gradient of contamination. There was, however, statistically significant correlations noted with respect to polycyclic aromatic hydrocarbons (for both total PAHs and the PAH principal component) as well as for the metals principal component that was not related to ore contamination. There was also a statistically significant relationship observed between percent fines (which includes clay) and amphipod survival. As noted in Section 4.3.5, this could indicate a subtle relationship at the upper end of the clay measurements, but could also simply be an autocorrelation (i.e., percent fines are correlated to non-ore related metals) rather than indicative of a potential cause and effect relationship.

Table 3: Summary of Spearman Rank Correlations

Parameters	Sea Urchin Normal Survival	Amphipod Survival	Polychaete Survival	Polychaete Growth
Physical Characteristics				
Percent TOC	-0.484	-0.425	-0.111	-0.473
Percent Fines	-0.468	**-0.847**	0.005	-0.253
Ore-Related Contaminants				
Copper	-0.305	-0.075	0.062	-0.301
Mercury	-0.380	-0.249	-0.055	-0.398
Lead	-0.372	-0.244	-0.030	-0.354
Zinc	-0.429	-0.370	-0.100	-0.477
Metals PC2	0.143	-0.068	0.074	0.213
Other Contaminants				
Metals PC1	**-0.613**	**-0.807**	-0.121	-0.459
PAHs PC1	**-0.626**	-0.519	-0.392	**-0.618**
Total PAHs	**-0.634**	-0.524	-0.406	**-0.614**

Note: Significant correlations ($p<0.05$; n= 14; rs = 0.538) are **bold and underlined**

4.4 Toxicity Identification Evaluation

A toxicity identification evaluation (TIE) was initiated to obtain more information about the likely cause of toxicity observed in the sediment toxicity tests. TIE entails a combination of sample manipulations and toxicity tests to determine which manipulations alter sample toxicity. Each treatment involves physical or chemical manipulations of the sample that targets specific substances, followed by toxicity tests on the treated and untreated samples. A change in toxicity because of the treatment indicates that the substance was contributing to the toxicity in the original sample. Golder noted that many samples demonstrated significant reductions in sea urchin normal survival despite an absence of metals or PAHs at concentrations greater than the numerical SCO criteria (Section 4.3.2). Although there were indicators that ore-related metals were unlikely to be the primary cause of the observed toxicity (see Sections 2.1.3, 4.2.4 and 4.3.6), it was considered appropriate to obtain further confirmation to support site management planning.

4.4.1 Approach and Results

The report from the subcontractor laboratory is provided in Appendix E-3. The design of the TIE was done in collaboration with Golder, and included:

- **Review of Initial Baseline Sediment Toxicity Tests –** TIE methods are most effective when applied to sediments that exhibit clear overt toxicity, as opposed to variable responses or marginal toxicity. The results from the initial 96-hour survival and development tests with *S. purpuratus* and 10-day survival tests with *E. estuarius* was reviewed (Figure 14). Two samples (SED17-09 and SED17-13) were identified for the first round of the TIE toxicity testing. These samples contained concentrations of ore-related metals and PAHs that were greater than the numerical standard, and caused effects to both amphipods and sea urchins. The TIE focused on the sea urchin test because it had the higher observed effect.
- **Round One –** The TIE was based on porewater-only exposures. Porewater was extracted on 26 May 2017 from the bulk archived sediment sample through centrifugation. Samples were not filtered. The following treatments were tested on the same day using 100% porewater:
  - Untreated.
  - C18 solid phase extraction column – A subsample was passed through a column to remove non-polar organic molecules such as PAHs.
  - EDTA – Subsamples were treated with two concentrations of EDTA (at 20 or 100 mg/L) to chelate different amounts of ore-related metal cations.
- **Round Two** – A second round of TIE was conducted. Porewater was extracted on 7 July 2017 from SED17-09, SED17-13 and a third sample (SED17-22) following the same method described above. The following treatments were tested on the same day on a dilution series of five different porewater concentrations (0, 6.2, 12.5, 25, 50 and 100% volume/volume). The dilution series was created with clean, natural seawater.
  - Untreated.
  - C18 solid phase extraction column.
  - EDTA (100 mg/L).

As part of Round 2, each of the three treatments was also used in a reference toxicant test to establish the toxic threshold for unionized ammonia. For example, clean seawater was spiked with a range of different ammonia (0.7, 1.56, 3.1, 6.2, 12.5 and 25 mg/L N) concentrations and the EC50 was calculated. A separate EC50 was determined for ammonia spiked in seawater that had been treated with the C18 column, or for ammonia spiked into seawater that had 20 mg/L EDTA added. The concentrations of copper, mercury, lead and zinc were also measured in the 100% porewater samples tested in Round 2 so that those concentrations could be compared to species-specific toxicity thresholds for each metal.

The toxicological performance of the various TIE treatments is provided in Tables 4 and 5 for Round 1 and Round 2, respectively.

Table 4: Summary of Round 1 TIE

Sample ID	TIE Treatment	Sea Urchin Larval Survival (%; Mean ± Standard Deviation)	Sea Urchin Normal Survival (%; Mean ± Standard Deviation)
Laboratory Control (Seawater)	**Untreated**	89.0 ± 6.9	71.9 ± 5.3
	C_{18}	88.3 ± 4.2	71.4 ± 4.2
	EDTA (20 mg/L)	85.9 ± 6.4	70.1 ± 4.9
	EDTA (100 mg/L)	91.3 ± 2.5	70.7 ± 2.1
SED17-09	**Untreated**	74.7 ± 3.6	0
	C_{18}	68.4 ± 4.5	0
	EDTA (20 mg/L)	75.5 ± 2.7	0
	EDTA (100 mg/L)	80.8 ± 4.9	0
SED17-13	**Untreated**	84.9 ± 2.4	3.0 ± 1.8
	C_{18}	81.4 ± 2.9	3.6 ± 0.8
	EDTA (20 mg/L)	89.4 ± 2.2	4.5 ± 2.4
	EDTA (100 mg/L)	88.7 ± 1.9	6.2 ± 1.9

Table 5: Summary of Round 2 TIE

Sample ID	Test Concentration (%/v/v porewater)	Sea Urchin Survival (%; Mean ± Standard Deviation)			Sea Urchin Normal Survival (%; Mean ± Standard Deviation)		
		Untreated	C_{18}	EDTA (100 mg/L)	Untreated	C_{18}	EDTA (100 mg/L)
SED17-09	**Control (0)**	89.7 ± 8.8	87.5 ± 10.3	84.1 ± 7.5	87.9 ± 7.9	85.5 ± 11.2	82.2 ± 6.9
	6.2	79.8 ± 4.4	88.5 ± 2.5	79.6 ± 5	77.5 ± 4.0	86.0 ± 1.5	78.1 ± 5.3
	12.5	84.6 ± 8.4	85.6 ± 4.4	88.2 ± 1.5	83.4 ± 8.2	84.0 ± 3.5	86.3 ± 2.1
	25	89.3 ± 9.5	90.6 ± 2.5	91.5 ± 4.1	87.5 ± 9.8	88.8 ± 2.4	88.7 ± 5.2
	50	86.4 ± 5.5	88.5 ± 3.2	88.8 ± 4.2	34.1 ± 2.7	5.0 ± 1.2	1.8 ± 2.1
	100	68 ± 14.9	46.1 ± 3.1	67.5 ± 4.0	0	0	0
SED17-13	**Control (0)**	82.9 ± 3.0	87.5 ± 10.3	84.1 ± 7.5	81.7 ± 2.7	85.5 ± 11.2	82.2 ± 6.9
	6.2	82.8 ± 5.7	83.8 ± 7.3	78.1 ± 3.6	81.9 ± 5.4	82.5 ± 6.8	74.9 ± 4.8
	12.5	85.5 ± 3.3	87.8 ± 4.1	84.4 ± 8	83.7 ± 2.1	86.9 ± 3.9	82.0 ± 7.5
	25	82.9 ± 2.4	89.3 ± 8.3	90.3 ± 5.5	81.9 ± 2.0	86.7 ± 8.2	87.6 ± 6.7
	50	92.9 ± 9.8	90.5 ± 6.4	84.9 ± 7.5	92.0 ± 9.2	88.5 ± 7.9	82.2 ± 7.8
	100	89.6 ± 11.3	95.8 ± 2.2	81.4 ± 3.5	13.6 ± 4.0	32.5 ± 1.7	13.9 ± 4.1
SED17-22	**Control (0)**	82.6 ± 3.7	87.5 ± 10.3	84.1 ± 7.5	80.5 ± 3.8	85.5 ± 11.2	82.2 ± 6.9
	6.2	87.5 ± 7.9	88.1 ± 5.4	84.0 ± 1.0	85.6 ± 8.2	85.6 ± 6.0	81.9 ± 2.3
	12.5	86.3 ± 6.6	89.0 ± 5.4	90.5 ± 8.8	63.3 ± 2.0	81.0 ± 4.4	76.7 ± 8.5
	25	46.7 ± 2.7	75.4 ± 5	60.3 ± 7.9	0	0	0
	50	33.7 ± 5.3	58.8 ± 10.3	31.7 ± 4.8	0	0	0
	100	45.3 ± 6.0	61.0 ± 3.5	47.4 ± 3.5	0	0	0

4.4.2 Discussion

Data are summarized for both survival and normal survival of the sea urchin larvae in Tables 4 and 5. The following summary provides the balance of evidence for various hypotheses regarding the identity of the specific substances causing the observed toxicity:

- **Influence of physical variables.** There is a general pattern in larval development tests where a major reduction in survival (without abnormal development) suggests that entrainment is occurring (i.e., fine-grained or colloidal particles in the porewater samples remain in suspension, and then gradually settle out and smother the sea urchin larvae). In this data set, survival remained high in the test treatments, and the reductions in normal survival are largely attributed to the malformation of the developing sea urchin larvae. Malformation of the developing larvae is typically associated with a chemical effect, not a physical effect. Golder concludes that there is one or more substances present in these samples that are contributing to the observed effect.

- **Influence of ore-related metals.** The primary objective of the TIE was to determine if ore-related metals were the cause of the observed toxicity. Ore-related metals (i.e., lead, zinc, mercury or copper) are not likely to be the cause of the observed toxicity in the samples tested based on the balance of information. Treatment of the samples with EDTA did not result in any measurable improvement in the Round 1 testing (Table 3) relative to the untreated sample. Treatment with EDTA is a default method in TIE for metals and EDTA is known to bind to positively charged ions in general, and divalent transition metals such as cadmium, copper, nickel, lead and zinc (Burgess et al. 1996). All the primary ore-related metals are bound by EDTA. Arsenic is also potentially related to ore concentrates but was not present in sediment at elevated concentrations. Arsenic is bound by EDTA at a lesser degree than the divalent metal ions noted above but is still part of the suite of metals covered by EDTA chelation (USEPA 1991).

  A similar pattern was observed in the Round 2 testing. Concentrations of ore-related metals in porewater concentrations were measured in the 100% porewater treatments from Round 2. Concentrations were consistently less than toxicity threshold values, and in the case of lead and zinc, were not present at detectable concentrations in any of the three samples.

  - Copper concentrations ranged from 0.23 to 0.61 µg/L in the untreated aliquots of SED17-09, SED17-13 and SED17-22 relative to a 96h sea urchin normal development EC50 of 28 µg/L. This toxicity threshold was determined based on a spiked seawater reference toxicant test conducted with the same batch of organisms.

  - Mercury concentrations ranged from <0.51 to 1.1 µg/L in the untreated aliquots of SED17-09, SED17-13 and SED17-22. The range of EC50 values for five different sea urchin larval development tests with *Paracentrotus lividus* or *Arbacia punctulata* has ranged from 8 to 46 µg/L (Novelli et al. 2003; Fernandez and Beiras 2001; His et al. 1999; Carr et al. 1996; Warnau et al. 1996).

  - Zinc concentrations were <0.15 µg/L in the untreated aliquots of SED17-09, SED17-13 and SED17-22 relative to a 72-h sea urchin normal development EC50 of 151 µg/L (Nadella et al. 2013). The no observed effect concentration from Nadella et al. (2013) was 109 µg/L.

- Lead concentrations were <0.125 µg/L in the untreated aliquots of SED17-09, SED17-13 and SED17-22 relative to a 72-h sea urchin normal development EC50 of 151 µg/L (Nadella et al. 2013). The no observed effect concentration from Nadella et al. (2013) was 2.7 µg/L.

- **Influence of PAHs.** Both SED17-09 and SED17-13 had concentrations of several high molecular weight PAHs that exceeded the numerical chemical criteria (Section 4.2.3). There was no improvement noted in the C18 treatment in Round 1, but a marginal improvement was noted where the toxicity was reduced in the 100% v/v treatment of SED17-13 relative to the untreated sample. It is not possible to conclusively state that this is because the SPE column extracted PAHs from the sample (i.e., the column extracts non-polar organics, not just those specific high molecular weight PAHs).

Ultimately, the TIE confirmed that ore-related metals were not causing the observed toxicity in SED17-09 and SED17-13 (and by extension, in other samples). The inclusion of SED17-22 in the Round 2 TIE highlights that toxicity occurs despite the absence of elevated concentrations of metals or PAHs in sediment. This observation suggests a third substance (or group of substances) that have not been evaluated is actually the primary cause of toxicity. This is consistent with the TIE findings from TetraTech (2008) who also confirmed that metals were not likely the cause of toxicity, and that there was a substance that was not volatile that was present in the samples.

Golder reviewed the available data for further insight about the identity of the primary toxicant. This review focused on ammonia and identified that:

- The unionized fraction of ammonia in SED17-13 in the Round 1 TIE testing was 0.05 mg/L which was higher than the generic threshold of 0.014 mg/L unionized N proposed by the test method.

- More importantly, the ammonia concentrations in this sample increased over time while the sample was stored in cold, dark conditions, which indicates that microbial degradation was occurring. A similar pattern of increasing ammonia concentrations over time was noted for SED17-09—concentrations had increased to 11 mg/L total N by July. The unionized ammonia concentration that corresponds to a total ammonia concentration of 11 mg/L is 0.08 mg/L unionized N, which is also greater than the species-specific threshold of 0.06 mg/L unionized N from Greenstein et. al (1996).

- A spiked-water bioassay with ammonia was conducted concurrently with the Round 2 TIE to provide a toxicity threshold for the specific organisms tested (instead of using a threshold value from the literature). An EC50 of 0.08 (95% confidence interval: 0.074 – 0.084) mg/L unionized ammonia was established, along with an EC20 of 0.065 (95% confidence interval: 0.058 to 0.070) mg/L. These values are slightly lower than Greenstein et al. (1996) who found a no-observed effect concentration of 0.06 mg/L.

- The relationship between unionized ammonia concentrations in different TIE treatments and the ammonia reference toxicant test versus sea urchin normal survival is shown below on Figure 19 and highlights that the concentration-response relationship for ammonia is consistent with the pattern observed in the TIE treatments.

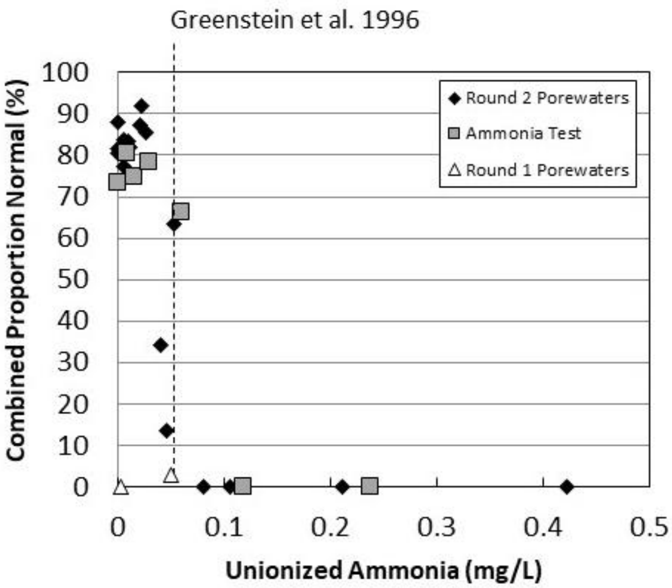


Figure 19: Ammonia concentrations versus sea urchin normal survival (modified from Nautilus TIE report)

4.4.3 Conclusion

The hypothesis that ammonia is the likely cause of the observed toxicity in the TIE needs to be presented in context. Significant reductions in sea urchin normal survival were observed in most baseline samples (Section 4.3.4), even though the water concentrations of ammonia were less than the Greenstein et al. (1996) toxicity threshold, as well as the EC20 values for ammonia determined in the TIE. Some of these samples also exerted significant reductions in amphipod survival, again, despite the observation that ammonia concentrations during testing were not of concern at the time of testing. Ammonia concentrations tended to increase over time and became more of an issue in the TIE than in the baseline sampling.

Golder interprets this as evidence that there are sewage-related substances present in sediment. Over time, sewage-related substances are degraded by micro-organisms and create ammonia. The ammonia concentrations increased over time to the point that they were sufficiently elevated to influence the TIE. In effect, ammonia is an indicator of the overall sewage and wastewater input, but not necessarily a toxicant in all test conditions. Ammonia is monitored as part of the municipal discharge permit as well as in discharges from cruise ships. There are sediment chemistry indicators that sewage inputs may be influencing sediment quality (Section 4.2.4), and a robust body of evidence that ore-related metals are not the primary toxicant. PAHs may have some limited influence, but that influence is not sufficient to explain the magnitude of toxicity observed, especially given that the TIE and the baseline toxicity testing program included samples that do not have elevated PAH concentrations.

Based on the available information, the current working hypothesis is that there are other organic substances (i.e., ammonia and potentially other substances) present in sediment related to sewage inputs. It was outside the scope of this risk assessment to conduct an exhaustive evaluation of the influence of different wastewater sources on sediment quality. At present, wastewater discharges appear to be the only source with a sufficiently large spatial influence to explain the observed toxicity data that has not been evaluated in detail.

4.5 Bioaccumulation

4.5.1 Approach

The review of historical data indicated that information about the uptake of ore-related metals and other potential contaminants was relatively limited in terms of sample diversity, chemical analysis and spatial coverage (Section 2.1.5). The most recent historical sampling was reported by Tetra Tech (2008) which may no longer be representative of current bioaccumulation patterns, especially considering the conclusion that deposition of clean material from the Skagway River is occurring (Section 3.1). Additional sampling was proposed to provide updated information to assist in understanding the potential hazards to human and ecological receptors that may consume shellfish from the area. The sampling program (Appendix B) was not intended to provide a comprehensive data set for a quantitative risk analysis. Rather, it was a targeted program intended to provide a screening-level assessment of potential hazards (i.e., it involves a tiered approach). Golder collected shellfish (mussels, crabs, prawn[30]) from Skagway Harbour in spring 2017 and submitted them for metal and PAH analysis. The sampling locations are shown on Figure 14. There were a limited number of samples collected for each tissue type; therefore, the near-, mid- and far-field data were pooled (where applicable) to create a dataset representative of impacted (i.e., exposed) areas.

Table 6: Number of Shellfish Samples Collected

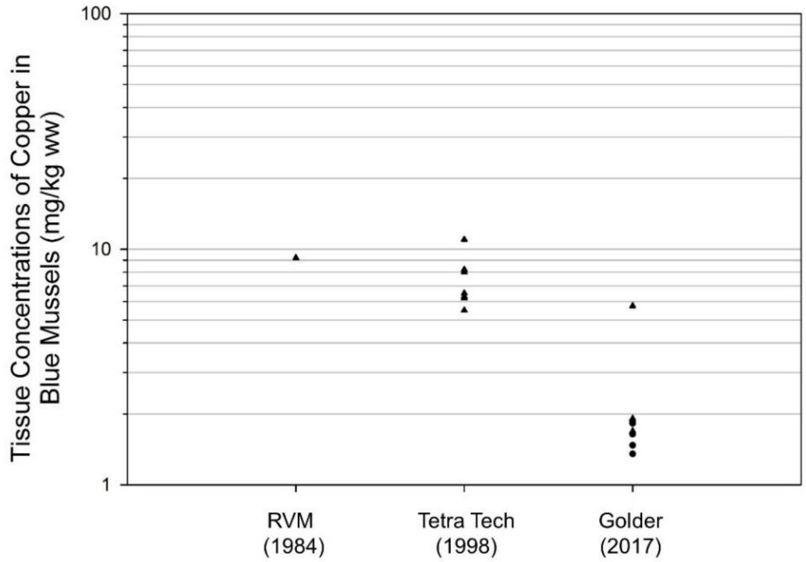
Area	**Crab** (Dungeness)	**Mussel** (Blue Mussel)	**Prawn** (Alaskan pink shrimp, spot prawn, coonstripe shrimp)
Near-field	3	5	5
Mid-field	5	No samples available	No samples available
Far-field	No samples available	5	No samples available
Exposed	**8**	**10**	**5**
Reference	**3**	**5**	**3**

Prawns were added to the sampling program because several local residents were catching shrimp from the harbor when Golder was present on site in May 2017. A commercial fishing vessel was also observed later in the year catching shrimp in Skagway Harbor.

4.5.2 Changes in Tissue Concentrations over Time

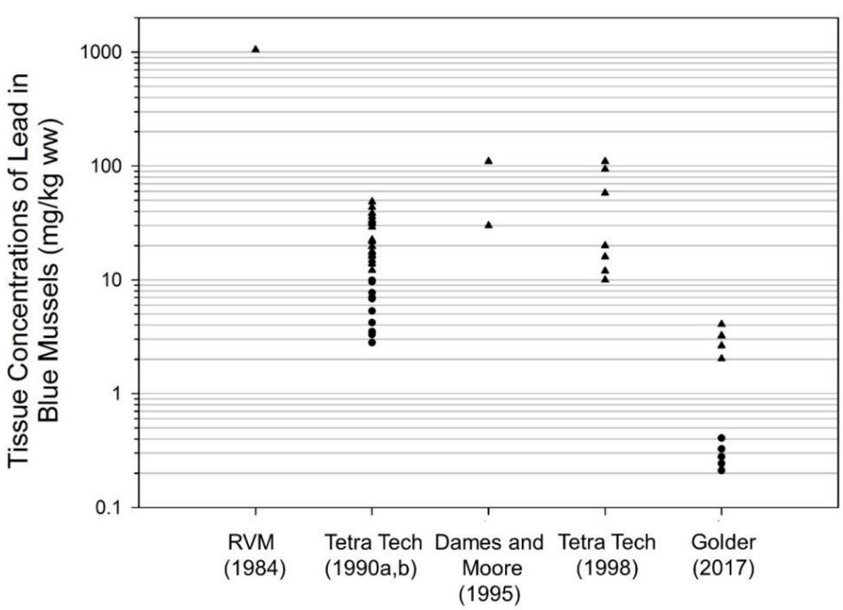
A total of four historical investigations involved analysis of one or more ore-related metals in field-collected fish or shellfish samples (Section 2.1.5). Figures 20 through 22 provide the individual sample results for copper, lead and zinc in mussels. Each data point represents an individual tissue measurement. Samples were classified as "near-field" if they were collected in the Ore Basin and "far-field" if they were collected elsewhere in Skagway Harbor. Other shellfish types or other metals are not graphed because they were not analyzed in the historical investigations. Note that the data value from RVM (1984) is the mean concentration as reported by that study. Concentrations in individual replicate samples were not reported by RVM (1984).

[30] Includes prawn and shrimp.



Notes: ▲ = Near-field stations; ● = Far-field stations; RVM (1984) data represents a mean value, discrete values were not reported

Figure 20: Copper concentrations in mussel samples



Notes: ▲ = Near-field stations; ● = Far-field stations; RVM (1984) data represents a mean value, discrete values were not reported

Figure 21: Lead concentrations in mussel samples

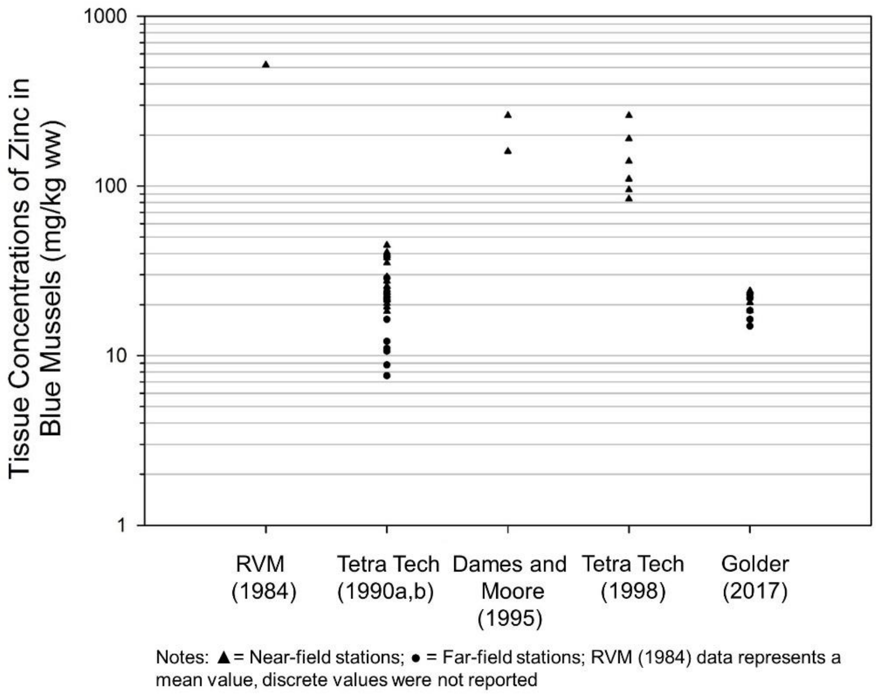


Figure 22: Zinc concentrations in mussel tissue

4.5.3 Potential Hazards for Consumption of Shellfish by People

4.5.3.1 Approach

The available shellfish data was screened in terms of its potential hazard vis a vis consumption by human receptor groups. A key consideration is that this screening process does not constitute a quantitative risk analysis. A human health risk assessment, if warranted, would typically require consideration of multiple exposure pathways rather than only consumption of shellfish. Not all pathways for human receptor groups would be related to sediment contamination. The quantitative risk analysis would also require further effort to determine a representative exposure scenario. Reliance on a maximum concentration is appropriate for a screening-level hazard assessment, but would be unnecessarily conservative in a quantitative risk analysis.

The screening process for this screening-level hazard assessment consisted of:

- Identification of substances of interest based on their potential for bioaccumulation.
- Determination of a reasonable worst-case estimate of shellfish consumption rates for the selected receptor groups.
- Calculation of a tissue screening limit based on the “safe” dose specified by regulatory guidance and the estimated shellfish consumption rates.
- Identification of which substances measured in shellfish exceed those tissue screening limits.

- Comparison of the concentrations measured in the "exposed" samples relative to reference concentrations to provide further context about whether concentrations in Skagway Harbor are at least partially influenced by natural background.

4.5.3.2 Potential for Bioaccumulation

ADEC (2015) defines an organic substance as bioaccumulative with a bioconcentration factor (BCF) greater than 1000 or a log Kow greater than 3.5. Inorganic substances (i.e., metals) are considered to be bioaccumulative if listed by USEPA (2000). ADEC (2010) list substances that are bioaccumulative based on this definition. The following substances are considered as bioaccumulative based on ADEC (2010) or because it has a BCF greater than 1000.

- Metals: Arsenic, cadmium, copper, lead, mercury, nickel, selenium, silver and zinc.
- PAHs: Benz(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, phenanthrene and pyrene. Benzo(a)pyrene and indeno(1,2,3-c,d)pyrene have BCFs greater than 1000, but were not detected in any of the shellfish samples.

There were no contaminants of potential concern related to the potential sources described in the problem formulation (Section 2.2.1) that could be eliminated from consideration because of a low potential to bioaccumulate in aquatic organisms.

4.5.3.3 Shellfish Consumption Rates

ADEC (2015) recommends using the Community Subsistence Information System (ADFG 2017) to obtain subsistence wild food ingestion rates. However, high-end and median user rates for related shellfish (clams, crabs, Dungeness crab, king crab, tanner crab and shrimp) were not available for the Skagway dataset. Golder reviewed shellfish consumption rates from a variety of reference sources (including those specific to Alaska) to determine a realistic worst-case consumption rate. Merrill and Opheim (2013) conducted a subsistence food consumption survey of Alaska Natives in Seldovia, Port Graham, Nanwalek and Tyonek, who frequently consume traditional foods from Cook Inlet. The study reported a 95th percentile shellfish consumption rate of 36,700 mg/day. Ballew et al. (2004) evaluated the consumption patterns of Alaska Natives in five regions across the state. Skagway falls under the Southeast Alaska Regional Health Consortium. Participants in this region reported consuming shrimp, Dungeness crab, king crab and clams. The maximum consumption rate for these shellfish combined is 68,350 mg/day. These Alaska-specific values are lower than the default consumer-only shellfish ingestion rate of 176,000 mg/day (US EPA 2011). Ingestion rates from USEPA (2011) are intentionally conservative and took into consideration that people of different ages consume different amounts of shellfish. For adults, an ingestion rate of 2.2 g shellfish/kg body weight/day was based on the 95th percentile consumer-only intake of shellfish for the age 20 to 49 cohort. For toddlers, an ingestion rate of 3.5 g shellfish/kg body weight/day was based on the 1 to 2 years age group. These were the worst-case cohorts for adults and toddlers, respectively.

The following equation was used to adjust the shellfish ingestion rates to units of kilograms per day wet weight:

$$IR_{SF} = FIR \times BW$$

Where:

IR_{SF} = shellfish ingestion rate (kg/day ww)

FIR = food ingestion rate (g/kg/day ww)

BW = body weight (kg)

4.5.3.4 Calculation of Shellfish Screening Levels for Consumption

Regulatory limits for tissue concentrations consumed by humans for crab, mussel or prawns are not available from state or national jurisdictions. Therefore, the US EPA Regional Screening Level (RSL) Calculator (US EPA 2017a) was used to back-calculate screening levels for shellfish using risk assessment approaches. The lowest screening value (from adults or toddlers) was adopted as the final screening value. The equations are presented below, and assumed that the bioavailability of metals in consumed tissues would be 100%:

$$Non - Carcinogenic\ Screening\ Level = \frac{THQ \times AT \times ED \times BW}{EF \times ED \times \frac{1}{RfD} \times IR_{SF} \times CF}$$

$$Carcinogenic\ Screening\ Level = \frac{TR \times AT \times LT \times BW}{EF \times ED \times CSF \times IR_{SF} \times CF}$$

Table 7: Equation Inputs for Shellfish Screening Levels

Variable	Unit	Value	Source
THQ (target hazard quotient)	unitless	0.1	ADEC 2015
TR (target cancer risk)	unitless	0.000001	ADEC 2015
AT (averaging time)	days/year	365	Default
ED (exposure duration)			
Adult	year	26	ADEC 2015
Child	year	6	ADEC 2015
EF (exposure frequency)	days/year	365	ADEC 2015
LT (lifetime)	year	70	ADEC 2015
BW (body weight)			
Adult	kg	80	ADEC 2015
Child	kg	15	ADEC 2015
RfD (oral reference dose)	mg/kg/day	chemical-specific	US EPA 2017a
CSF (oral cancer slope factor)	$(mg/kg/day)^{-1}$	chemical-specific	US EPA 2017a
IR_{SF} (shellfish consumption rate)			
Adult (see Section 4.5.3.3 for calculation)	mg/day	176,000	US EPA 2011
Child (see Section 4.5.3.3 for calculation)	mg/day	52,500	US EPA 2011
CF (conversion factor)	kg/mg	0.0000001	-

Notes: kg = kilogram; mg = milligram

The RSL Calculator selects toxicity values (i.e., RfD and CSFs) using a hierarchy of preferred data sources which is consistent with ADEC (2015) guidance. The toxicity values are provided in Appendix E-4. The following decisions with respect to the selection of the toxicity values are highlighted:

- A toxicity value from the US EPA is not available for total chromium. The chromium screening level was derived using the hexavalent chromium toxicity value. This is conservative because the toxicity value for hexavalent chromium is lower than that for trivalent chromium. Golder submitted crab samples (8 exposed, 3 reference) for hexavalent chromium analysis as a secondary check once chromium was identified as a potential issue. Hexavalent chromium was not detected in any of the samples (method reporting limit ranged from 0.45 to 0.50 mg/kg ww), but the data were flagged because of the length of time between sampling and analysis. Samples were submitted to the lab within proper holding times following proper procedures for tissue preservation (i.e., samples were frozen after collection and stored frozen at the lab), but the laboratory has noted that hexavalent chromium tends to reduce to trivalent chromium in biological tissues over time. The hexavalent chromium data provides qualitative information that the hazard from chromium is likely less than what has been calculated using the total chromium tissue data.
- A toxicity value was not available for elemental mercury. Therefore, the methyl mercury toxicity value was used to derive the mercury screening level. It was conservatively assumed that 100% of the mercury in tissue was methyl mercury.
- A toxicity reference for lead is not available in the RSL Calculator because lead is typically assessed by determining blood lead concentrations from cumulative exposure rather than focusing on the hazard from one exposure pathway in isolation. Golder used the Integrated Exposure Update Biokinetic Model for Lead in Children (IEUBK; USEPA 2010) to back calculate a shellfish screening level for lead, assuming that other sources of lead in the environment would be similar to the model default values. In brief:
  - Default model parameters were used with the exception of a modification to the dietary intake assumptions. The model assumed that 100% of the meat and fish consumption would come from shellfish collected from Skagway Harbour. In reality, shellfish from Skagway Harbour may be a limited portion of a typical diet. For example, a significant fraction of the meat and fish consumption would originate from supermarkets.
  - Exposure to other sources of lead in the environment (e.g., indoor dust inhalation; consumption of vegetables; incidental ingestion of soil) was assumed to be equal to the US average concentrations.
  - The acceptable blood lead concentration was left at 10 micrograms per decilitre (µg/dL) per USEPA guidance (which is accepted by ADEC). This is a topic of ongoing regulatory discussion. The Center for Disease Control has adopted a blood lead reference value of 5 µg/dL (US EPA 2017b), and at least one state agency is recommending a value of 1 µg/dL (California EPA 2007).
- Toxicity values were not available for acenaphthylene, benzo(g,h,i)perylene and phenanthrene. In the absence of toxicity values for acenaphthylene, benzo(g,h,i)perylene and phenanthrene, these PAHs were evaluated using surrogates based on structurally similar compounds. Acenaphthene was used as a surrogate for acenaphthylene, benzo(a)pyrene for benzo(g,h,i)perylene and pyrene for phenanthrene.

4.5.3.5 Results for Ore-Related Metals

A summary of the screen limits, maximum observed concentration and range of reference concentrations for ore-related metals is provided in Table 8. All seven metals have the potential to accumulate in aquatic organisms. A metal was considered to present a hazard to human receptors if the maximum observed concentration exceeded the screening level and was substantially higher than the range of reference concentrations. As noted in Section 4.5.3.1, the presence of a hazard does not necessarily mean that there are risks. The hazard assessment is intentionally conservative in how the screening levels were derived, and was based on the maximum concentrations observed in any sample collected from Skagway Harbour. For individual ore-related metals:

- Arsenic concentrations exceeded the screening limits in both exposed and reference samples. The magnitude of this difference is because the screening limit assumes that 100% of the total arsenic is in the inorganic (i.e., more toxic form). The fraction of inorganic arsenic has not been established in shellfish from Skagway Harbour, but would be expected to be on the order of less than 10% based on consideration of multiple review papers (Borak and Hosgood 2007). From a hazard perspective, the key observation is that most tissue concentrations of crabs and mussels in Skagway Harbour were within the range of the reference concentrations. The maximum concentration of 19.3 mg/kg ww in prawns exceeded the range of reference concentrations.
- Cadmium concentrations exceeded the screening limits in both exposed and reference samples. Crabs and prawns also had a maximum concentration that was greater than the range of the reference concentrations, although the magnitude of that difference was relatively small with respect to crabs.
- Lead concentrations did not exceed the screening limit in reference samples. The maximum concentration in crabs was also less than the screening limit, but the maximum concentrations in mussels and prawns were greater than both the screening limit and the range of reference concentrations.
- Copper concentrations exceeded the screening limits in both exposed and reference samples. The maximum concentrations in mussels and prawns were greater than both the screening limit and the range of reference concentrations.
- Silver concentrations in all samples collected from the harbor were less than the screening limit, with the exception of prawns.
- Zinc concentrations exceeded the screening limits in both exposed and reference samples, but there were no indications that concentration from the harbor were greater than the range of reference samples.

In terms of different shellfish types:

- Prawns collected from exposed areas in the harbour tended to have concentrations of multiple ore-related metals that exceeded the screening limit and the range of concentration in the reference samples. Further consideration of arsenic, cadmium, mercury and silver may be appropriate. Interestingly, the three metals most closely related to the ore concentrates do not appear to share the same pattern. Copper and zinc concentrations from exposed sites do not appear to be substantially higher than the range of reference concentrations, and only one prawn sample had a lead concentration that was greater than the screening limit.
- Mussels from exposed areas had one or more samples with concentrations of copper, lead and mercury that exceeded the screening limit and were higher than the range of reference samples. This observation is more closely consistent with which metals are more likely related to the ore concentrate, unlike the pattern noted for prawns.
- Crabs from exposed areas tended to not have concentrations the exceeded the range of reference concentrations, with the exception of a single sample for cadmium. The overall accumulation of ore-related metals by crabs appears to be substantially less than mussels or prawns, which is consistent with the fact that crabs would likely have a relatively large home range that would limit the time they spend within the Ore Basin.

Table 8: Summary of Shellfish Tissue Screening Results for Ore-Related Metals (mg/kg wet weight)

	Screening Level	Crab		Mussel		Prawn	
		Exposed Concentration (n =8)	Reference Concentration (n = 3)	Exposed Concentration (n =10)	Reference Concentration (n = 5)	Exposed Concentration (n =5)	Reference Concentration (n = 3)
Arsenic	0.00082	1.83 - 4.35	3.49 - 5.47	2.1 - 2.9	2.09 - 3.03	1.2 - **19.3**	4.26 - 5.89
Cadmium	0.029	0.019 - **0.194**	0.043 - 0.107	0.94 - 1.56	0.94 - 1.5	0.08 - **0.487**	0.089 - 0.165
Copper	1.1	3.97 - 11.8	8.36 - 11.2	1.35 - **5.74**	1.5 - 3.02	6.4 - 22.1	7.24 - 69.6
Lead	1	0.02 - 0.282	0.010 - 0.018	0.21 - **4.07**	0.079 - 0.115	0.008 - **1.05**	<0.004 - 0.005
Mercury	0.0029	0.029 - 0.097	0.063 - 0.122	0.015 - **0.022**	0.011 - 0.015	0.023 - **0.046**	0.020 - 0.029
Silver	0.14	0.06 - 0.12	0.183 - 0.255	0.013 - 0.027	0.019 - 0.036	0.087- **0.443**	0.108 - 0.159
Zinc	8.6	23.7 - 47.2	32.4 - 48.5	14.9 - 24.1	16.6 - 21.6	9.8 - 16.7	10.7 - 14.4

Notes: Metals concentrations are in milligram per kilogram wet weight (mg/kg ww).

An underlined value is greater than the screening limit. A bold underlined value is greater than the screening limit and the range from the reference samples

4.5.3.6 Conclusions and Risk Management Considerations

Golder concludes that there is a potential hazard to human consuming shellfish from the site from ore-related contaminants that warrants further consideration. Identification of a hazard should not be interpreted as evidence that a risk is present, especially considering the conservative approach taken in the hazard assessment. Additional sampling and risk analysis would focus on reducing the conservatism of the current approach by:

- Developing a more realistic measure of concentrations (e.g., use an upper confidence limit of the mean instead of maximum).
- Evaluating the influence of metal speciation for substances such as mercury and arsenic.
- Refining the assumptions with respect to consumption rates (e.g., don't assume that people obtain 100% of their shellfish from the immediate area surrounding the Ore Basin).

A decision to proceed to a quantitative risk analysis with respect to ore-related metals also needs to consider factors other than the results of the conservative screening approach described above. In brief:

- The hazard screening also identified other substances. The screening approach considered metals that are not related to the ore concentrate, and PAHs (Appendix E-4). There were mussel and prawn concentrations of PAHs that also exceeded the back-calculated screening levels. Other metals (e.g., selenium, vanadium, iron, cobalt) also had one or more tissue samples that exceeded the conservative screening limits in some tissue samples. A risk analysis that focused exclusively on the ore-related contaminants would not necessarily be able to conclude that shellfish are safe to consume unless there was consideration of these other sources.
- The influence of wastewater discharges on shellfish quality has not been established. Any risk management decision regarding shellfish consumption should also consider the influence of wastewater discharges, especially considering the observation that the existing state discharge permit appears to require a shellfish consumption advisory that would apply to the entire harbor (Section 2.2.2). Golder has not conducted a comprehensive search for information on this topic, but notes that risks with respect to human consumption from ore-related metals would be managed if consumption did not include shellfish collected from the immediate vicinity of these potential sources.
- Golder is aware of two previous risk calculations applicable to the bioaccumulation of ore-related metals via shellfish. The findings from these previous assessments is provided for context. Golder has not conducted a comprehensive review of the specific methods or assumptions used. The two historical investigations are summarized:
  - Quantitative risk calculations were completed by TetraTech (1990b; draft) that used a similar approach as in the current hazard screening. Average tissue chemistry concentrations from TetraTech (1990a) were used to calculate a hazard quotient using similar exposure variables (e.g., body weight; shellfish ingestion rates) and the toxicity thresholds that were applicable at the time. The IEUBK model (version applicable at the time) was used to evaluate incremental risks associated with consumption of shellfish over and above what would be expected from a typical soil background concentration for Skagway.

Risks associated with shellfish did not exceed a hazard quotient of 1 for any of the three individual metals considered (mercury, zinc and lead), and the relative contribution of lead in shellfish to the predicted blood lead concentration was 5% or less based on the average concentrations of mussels or sole collected from the Ore Basin. Golder notes that the average concentrations have decreased since 1990 (see Section 4.5.2), which should further reduce the risks as calculated by TetraTech (1990b).

- ADHSS (1989) provide a summary report regarding a blood lead survey conducted in Skagway with 273 residents, in November 1988 and September 1989. This survey was conducted because elevated concentrations of ore-related metals were identified in soils near the ore warehouse and in areas adjacent to rail and roadways where ore concentrate was being hauled. Golder understands that soil remediation was subsequently completed. ADHSS (1989) found that 78% of the residents tested had blood lead concentrations less than 10 µg/dL. 19% of the residents had a concentration between 10 and 20 µg/dL with a small number of measurements that were greater than 20 µg/dL. All children tested had a blood lead concentration of less than 15 µg/dL, and the average concentration was between 8 and 8.7 µg/dL depending on the age cohort. ADHSS (1989) concluded that individuals with elevated blood lead concentrations were limited to workers at the ore terminal, and also concluded that the mean blood lead concentrations were consistent with other Alaskan populations that did not live near an ore concentrate loading facility. Although the specific threshold values used by ADHSS (1989) may have been refined over the last 25 years, the blood lead concentrations for the majority of individuals were less than the modern-day screening limit of 10 µg/dL. Sampling was also conducted prior to the enclosure of the ore conveyor system, and prior to any soil remediation. People who participated in the blood lead survey would have been exposed to lead through multiple pathways which have since been ameliorated to some degree[31] and which would have included consumption of shellfish from the harbour. This amelioration is evident from subsequent state-led blood lead monitoring data (ADHSS 2017) which showed that the maximum blood lead concentrations in children from the Skagway census area between 2002 and 2012 was less than 3 µg/dL.

4.5.4 Potential Hazards for Consumption by Wildlife

4.5.4.1 Approach

The potential hazards associated with wildlife consuming shellfish was evaluated using a food chain model. The food chain model estimated the total dose that the receptor would ingest by consuming food (and incidentally, consuming sediment) and compared it to a toxicity reference value that is associated with a no-observed adverse effect level from the literature. A hazard quotient less than 1 indicates that hazards to wildlife are unlikely to present.

The parameterization of the food chain model is summarized in Tables 9 through 11 and described in detail below:

- Average shellfish concentrations were calculated for the Ore Basin (based only on samples collected within the basin itself), for the remainder of the harbor and for the reference area. Receptors are assumed to be moving around each of these areas, and therefore, the average concentrations are a realistic measure of the exposure that wildlife might receive.

[31] For example, ingestion of soil and inhalation of outdoor dust is expected to have been at least partially ameliorated through the remedial excavations and improvements in the ore loading facility. The inhalation of indoor dust is expected to have been ameliorated through the discontinuation of the use of lead-based paints.

- Black oystercatcher and sea otter were selected as representative avian and mammalian receptors for the Southeast Alaska Ecoregion per ADEC (1999). Both species consume shellfish. Body weight of the black oystercatcher and the sea otter were taken from reputable sources in the literature.
- The amount of food that the receptor consumes per day was estimated from the body weight using allometric scaling equations for Nagy (1987). Nagy (1987) demonstrated that food consumption rates are proportional to an organism's body weight. The food consumption rates are calculated on a gram / day basis which is then converted to kg of shellfish (wet weight) per day using the average moisture content in the shellfish samples collected by Golder.
- A species-specific sediment ingestion rate was not identified in the literature, and therefore, it was assumed that sediment ingestion would not exceed 2% of the diet. Realistically, wildlife that are consuming crabs, shrimp and mussels would not be expected to have a high proportion of sediment in their diet because the prey is not buried in the sediment, and the act of capturing prey also means that the prey is being rinsed in the water column. Some wildlife receptors would dig for clams, or otherwise ingest large amounts of sediment from intertidal mudflats; however, Skagway Harbour is largely lined by steep riprap walls or port infrastructure, and there are only limited areas where intertidal sediment would be exposed. The assumption that oystercatchers and otters are consuming 2% of their diet as sediment is conservative.
- A no-observed adverse effect level (NOAEL)-based value was adopted from USEPA ecological soil screening level (ECO-SSL; USEPA 2018) guidance wherever possible. If an ECO-SSL NOAEL-based value was not available, a NOAEL-based value from Oak Ridge National Laboratory (ORNL; Sample et al. 1996) was used.

Table 9: Receptor Parameterization

	Bird (Black Oystercatcher)		Mammal (Sea Otter)	
	Value	**Source**	**Value**	**Source**
Body Weight	0.55 kg	Andres and Falxa (1995)	34 kg	Average of male and female body weight ranges provided in USFWS (2012)
Food Ingestion Rate (dry weight)	0.04 kg dw per day	"Seabird" allometric food ingestion rate predicted by Nagy (1987)	1.25 kg dw per day	"All mammal" allometric food ingestion rate predicted by Nagy (1987)
Food Ingestion Rate (wet weight)	0.21 kg ww per day	Converted dry weight to wet weight with site-specific average moisture content of 80% in shellfish	6.24 kg ww per day	Converted dry weight to wet weight with site-specific average moisture content of 80% in shellfish
Sediment Ingestion Rate	0.004 kg per day	Assumed 2% of food ingestion rate. There is limited intertidal sediment in the harbour and prey items would be captured in the water column.	0.13 kg per day	Assumed 2% of food ingestion rate. There is limited intertidal sediment in the harbour and prey items would be captured in the water column.

Table 10: Average Shellfish Concentrations Used in Food Chain Model

	Ore-Basin (mg/kg ww)	Rest of Harbor (mg/kg ww)	Reference (mg/kg ww)
Arsenic	5.2	2.7	3.7
Cadmium	0.65	0.70	0.60
Chromium	0.42	0.35	0.34
Copper	7.8	4.3	5.3 (Note 1)
Lead	1.3	0.19	0.05
Mercury	0.04	0.04	0.04
Silver	0.11	0.06	0.11
Zinc	23.4	26.2	23.0

Note: Excluded copper concentration of 69 mg/kg from REF-PRAWN-02 which is potentially an anomaly. Average concentration in the reference area with this sample included would be higher.

Table 11: Summary of NOAEL-based Toxicity Reference Values (mg/kg/day)

	Bird (Black Oystercatcher)		Mammal (Sea Otter)	
	TRV	Source	TRV	Source
Arsenic	2.24	Lowest NOAEL from ECOSSL (insufficient data points for a geometric mean)	2.47	Geomean of NOAELs from ECO-SSL
Cadmium	1.47	Geomean of NOAELs from ECO-SSL	1.86	Geomean of NOAELs from ECO-SSL
Chromium	2.66	Geomean of NOAELs from ECO-SSL	2.40	Geomean of NOAELs from ECO-SSL
Copper	18.5	Geomean of NOAELs from ECO-SSL	25.0	Geomean of NOAELs from ECO-SSL
Lead	10.9	Geomean of NOAELs from ECO-SSL	40.7	Geomean of NOAELs from ECO-SSL
Mercury	0.45	NOAEL from ORNL	1.0	NOAEL from ORNL
Silver	2.02	Lowest LOAEL / 10 from ECOSSL	6.02	Lowest LOAEL / 10 from ECOSSL
Zinc	66.1	Geomean of NOAELs from ECO-SSL	75.4	Geomean of NOAELs from ECO-SSL

Note: ECO-SSL = USEPA (2018); ORNL = Sample et al. (1996)

4.5.4.2 Results

The food chain model outputs are provided in Appendix E and the hazard quotients are summarized below in Table 12. All three areas evaluated with a screening-level food chain model had hazard quotients that were less than 1, indicating that hazards to wildlife that consume shellfish are low.

Table 12: Summary of Hazard Quotients for Wildlife Receptors

	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Silver	Zinc
Black Oystercatcher								
Ore Basin	0.9	0.2	0.1	0.2	0.2	<0.1	<0.1	0.2
Rest of Harbor	0.5	0.2	0.1	0.1	<0.1	<0.1	<0.1	0.2
Reference	0.6	0.2	0.1	0.1	<0.1	<0.1	<0.1	0.1
Sea Otter								
Ore Basin	0.4	0.1	0.1	0.1	<0.1	<0.1	<0.1	0.1
Rest of Harbor	0.2	0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1
Reference	0.3	0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1

4.5.4.3 Conclusions and Risk Management Considerations

Golder concludes that there are low hazards to birds and mammals that could consume shellfish from the site from ore-related contaminants. This conclusion considers the fact that the screening-level food chain model incorporated several conservative assumptions (described in further detail below). Notwithstanding this conclusion, Golder notes that average tissue concentrations were used in the model because there were insufficient tissue samples available from each area to allow for the calculation of a more conservative exposure estimate (e.g., the 95th upper confidence limit of the mean). Further refinement of the food chain model to use different assumptions is not expected to change the overall conclusion, however, this model should be updated with any additional tissue data that might be collected as part of a post-remedial monitoring program to confirm that these conclusions continue to be valid.

Golder notes that the model used conservative, no-observed effect toxicity reference values and assumed that the receptor would obtain 100% of their food from a given area. Realistically, both receptors would consume prey items harvested over a much larger area than the Ore Basin—sea otters, for example, consume up to 25% of the body weight in food each day. The model also assumes that 100% of the tissue concentrations are absorbed by the animal through its gastrointestinal tract when realistically, a large proportion of the ingested dose is passed through the wildlife and is not absorbed by the gastrointestinal tract. Golder concluded that it was reasonable to use the average tissue concentration based on all tissue samples (from a given area) under these circumstances because otters and oystercatchers are expected to consume all three prey types (crabs, mussels and shrimp) from all parts of a given area. Further refinement of the food chain model to evaluate different dietary proportions would not be expected to substantially change the conclusion, and therefore, further consideration of this pathway does not appear to be warranted unless future tissue monitoring identifies a substantial change in concentrations for one or more ore-related contaminants.

5.0 CONCLUSION

5.1 Summary of Findings and Recommendations

The following section provides an overall conclusion, identifies areas of uncertainty in how the conclusion was developed, and makes recommendations for how this sediment assessment can help inform site management planning. Previous investigations had documented the presence of lead, zinc and mercury at concentrations that exceeded numerical guidelines for the protection of benthic organisms. The magnitude of these exceedances was considerable in some samples, and the pattern of contamination indicated that the ore concentrate handling facility was the likely source. The magnitude of the exceedance and pattern of contamination was consistent with historical ore concentrate handling practices. Consequently, some previous investigations have recommended that the Ore Basin should be dredged as a priority to resolve the perceived environmental risks.

What was the objective?

The objective of the assessment was to inform risk-based management. The risk associated with a contaminant source will be influenced by contaminant bioavailability, spatial extent, and other considerations. A decision to dredge based only on total concentrations does not address these underlying risk questions, even if it is practical in some circumstances. There are other options for achieving biological improvement at a contaminated site. For example, monitored natural attenuation is often equally effective in achieving biological improvement because ongoing future inputs of sediment with lower contaminant concentrations act as a natural cap. Risk-based management focuses on managing the risk in the context of current and future site plans—not all options will be equally effective for all development scenarios.

What did we learn about hazards to aquatic organisms?

Golder completed a supplemental sediment investigation to help inform site management decisions regarding the ore-related sediment contamination. A preliminary sediment transport analysis showed that the site is largely depositional and likely receiving inputs of clean sediment from the Skagway River. There are some areas where propeller scouring is likely occurring, but they are limited in spatial extent and do not appear to overlap with the areas with highly-elevated ore concentrations. The sediment chemistry data collected by Golder supports the sediment transport analysis. Concentrations of ore-related metals in the current surface sediment of the Ore Basin are lower than previous investigations, and the difference between current surface and deeper sediment quality along the ore dock was evident in the statistical analysis.

The effects associated with the current surface sediment in the Ore Basin was evaluated with a battery of three different toxicity tests to represent different parts of the benthic community. Samples for toxicity testing represented the range of ore-related metals in the current surface sediment. This gradient also provided spatial coverage for the Ore Basin (instead of focusing exclusively on the area around the ore loading system) and included samples from elsewhere in Skagway Harbor as well as reference areas. Many of the samples showed an unacceptable effect, even though the concentrations of ore-related metals and polycyclic aromatic hydrocarbons did not exceed conservative guidelines for the protection of benthic organisms.

A toxicity identification evaluation was completed on a subset of samples. Ore-related metals such as copper, lead, zinc and mercury were confirmed not be the primary cause of toxicity. This conclusion from the toxicity identification evaluation was supported by statistical analysis which showed there was not a statistically significant relationship between ore-related metals in sediment and the effects observed in the toxicity tests. The conclusion is also consistent with the findings from a toxicity identification evaluation completed by a previous consultant. Golder concluded that sewage inputs (including ammonia) may be exerting a negative effect on sediment quality in the Ore Basin based on the balance of available information. Further consideration of the effect of long-term loading of wastewater discharges from municipal and cruise ship sources may be appropriate.

What did we learn about metal bioaccumulation in shellfish?

Although ore-related metals do not appear to be exerting direct toxicity on benthic organisms, the mass of the contamination present in sediment is still influencing aquatic food chains. Tissue samples were collected for mussels, shrimp and crabs from within the Ore Basin, elsewhere in Skagway Harbor, and at reference areas. There were species-specific differences in how metals are being accumulated, which is expected based on differences in feeding strategy and home range mobility. Overall, concentrations in mussels appear to be decreasing over time.

What did we learn about hazards related to shellfish consumption by people?

All seven of the ore-related metals exceeded conservative screening values for the consumption of shellfish. Exceedances of these screening limits were also observed in samples from the reference area, but overall, concentrations of metals related to ore concentrates were higher in at least one tissue sample collected from the site relative to reference concentrations.

The presence of a maximum concentration that exceeds a conservative screening value does not necessarily mean that there are risks to people consuming shellfish from the harbor. The preliminary sampling also showed that there were a small number of shellfish samples that were also accumulating polycyclic aromatic hydrocarbons, and that metals unrelated to ore concentrates also exceeded the conservative screening values in some samples. Further sampling to determine a defensible average concentration in the specific shellfish types being consumed may be appropriate and would be necessary to provide a more refined evaluation regarding risks to humans.

Further risk evaluation, if conducted, should also consider administrative controls on shellfish consumption. Administrative controls are a common element of risk management plans for contaminated sediment. Golder understands that shellfish harvesting from Skagway Harbor is not permitted because of the presence of the municipal wastewater discharge.

What did we learn about hazards related to shellfish consumption by wildlife?

Golder concludes that there are low hazards to birds and mammals that could consume shellfish from the site from ore-related contaminants. The food chain model used conservative, no-observed effect toxicity reference values and assumed that the receptor would obtain 100% of their food from a given area. Realistically, receptors would consume prey items harvested over a much larger area than the Ore Basin. The model also assumes that 100% of the tissue concentrations are absorbed by the animal through its gastrointestinal tract when in fact, a large proportion of the ingested dose is passed through the wildlife and is not absorbed by the gastrointestinal tract. Golder concluded that it was reasonable to use the average tissue concentration based on all tissue samples (from a given area) under these circumstances because otters and oystercatchers are expected to consume all three prey types (crabs, mussels and shrimp) from all parts of a given area. Further refinement of the food chain model to evaluate different dietary proportions would not be expected to substantially change this conclusion. However, Golder notes that average tissue concentrations were used in the model because there were insufficient tissue samples available from each area to allow for the calculation of a more conservative exposure estimate (e.g., the 95th upper confidence limit of the mean), and therefore, the model should be updated with any additional tissue data that might be collected as part of a post-remedial monitoring program to confirm that these conclusions continue to be valid.

What are the major sources of uncertainty in this conclusion?

Any risk management decision based on this risk evaluation should consider the uncertainty associated with both the underlying data and how it was evaluated. Uncertainty is present in all environmental assessments, and therefore, steps are taken through the assessment process to minimize uncertainty to the extent possible, and then to describe the residual sources of uncertainty clearly so that risk managers and regulatory decision-makers can balance those factors in deciding an appropriate course of action.

Methodological uncertainty in chemistry and toxicity data was minimized by applying accepted procedures for quality assurance and quality control during all stages of data acquisition. No substantive quality issues were identified during the investigation that would limit the utility of the data for making a site management decision. Data that were collected with variance from standardized protocols (such as chemical analysis on archive samples outside the hold-time) are identified in the report and the merits of considering such data discussed. In those instances, data are typically treated as a qualitative indicator. Other sources of uncertainty include study design topics such as the number and spatial coverage of sampling. Tissue sampling, for example, was limited in this respect, but still appropriate for a screening-level risk assessment.

Risk assessment is inherently a tiered process, and therefore, conservative assumptions and guidelines were applied throughout the risk evaluation to avoid erroneously concluding that a risk is present if in fact it is not. In a screening-level risk assessment, the goal is to eliminate issues that do not require further consideration based on a conservative evaluation. Issues that cannot be eliminated at the screening level do not necessarily present an actual risk, and the decision to proceed with a more refined risk evaluation would typically be done in conjunction with a remedial options analysis.

What are the next steps?

Golder concludes that metals are not the major cause of adverse effects observed in the toxicity tests, although ore-related metals are accumulating in the portion of the aquatic food chain that was assessed. This conclusion was based on a robust toxicity testing program in conjunction with a specialized toxicity identification evaluation process. Additional toxicity testing or assessment of the benthic community structure in the Ore Basin are not considered likely to change this conclusion.

Further discussion with the appropriate regulatory agency about the value of conducting a more refined evaluation of human health exposures is recommended. The main uncertainty relates to the fact that the human health calculation was completed on a relatively small number of samples (which is appropriate for a screening-level assessment). The screening-level risk assessment identified several issues that may relate to wastewater discharges that are subject to other state regulatory processes and have approved initial dilution zones that encompass the Ore Basin. Wastewater management practices may already have resulted in administrative controls that would mitigate the human health exposures via the shellfish consumption pathway. Notwithstanding the technical rationale to refine some elements of the risk assessment, Golder acknowledges that that there may be practical or operational considerations regarding the need to dredge some parts of the Ore Basin. Removal of a portion of the mass of metals related to ore concentrates would be expected to further reduce the potential uptake of these metals by shellfish and follow-up sampling of shellfish tissue concentrations as part of post-remedial monitoring is considered appropriate. These data can be used to provide more information about potential hazards to human health and wildlife as described in this report.

In terms of remedial design, Golder notes that the available data are not sufficient to establish a quantitative relationship between mass removed and future tissue concentrations, nor is it likely that such a relationship would be developed in the future. However, the limits of the volume to be dredged should not be established using default sediment guidelines because multiple lines of evidence in the assessment have established that metal bioavailability to benthic organisms is substantially lower than the assumptions that are inherent in the guideline derivation.

5.2 Closure

We trust that this report meets your current needs. If you have any questions, or if we may be of further assistance, please do not hesitate to contact the undersigned.

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APPENDIX A

Sediment Transport Analysis

TECHNICAL MEMORANDUM

DATE 28 February 2017 **REFERENCE No.** 1657231-001-TM-Rev0

TO Mr. John Finlayson, President,
White Pass & Yukon Route Railway - P.O. Box 435, Skagway, AK, 99840

CC Tamra Reynolds, Blair McDonald

FROM Phil Osborne, PhD, PGeo and Greg Curtiss, PE **EMAIL** Phil_Osborne@golder.com

SKAGWAY PRELIMINARY SEDIMENT TRANSPORT ASSESSMENT

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was tasked by the White Pass and Yukon Route Railroad (WP&YR) to conduct a desktop review and assessment of sediment transport processes at the Skagway Ore Terminal harbor basin (Figure 1) using existing information to determine the likelihood of erosion and deposition of bed sediments in the basin under natural occurring processes and from vessel propeller wash. The assessment was completed in three tasks:

- Task 1 – review existing relevant site specific information including: aerial photographs, bathymetric soundings, sediment sampling and characterization, dredging information, water levels, tidal currents, river flows, wind and wave data, and vessel usage in the harbor;
- Task 2 – complete a preliminary assessment of the natural processes occurring in the basin (wind, currents, waves, tides, river flows) and determine their potential to result in erosion or deposition of bed sediment in the ship basin;
- Task 3 – complete a preliminary assessment of vessel propeller wash scour velocities in the ship basin and determine if they are sufficient to re-suspend and re-distribute bed sediments.

This technical memorandum summarizes Tasks 1 through 3. This memorandum should be read in conjunction with the "Important Information and Limitations of this Technical Memorandum" as this forms an integral part of this document.

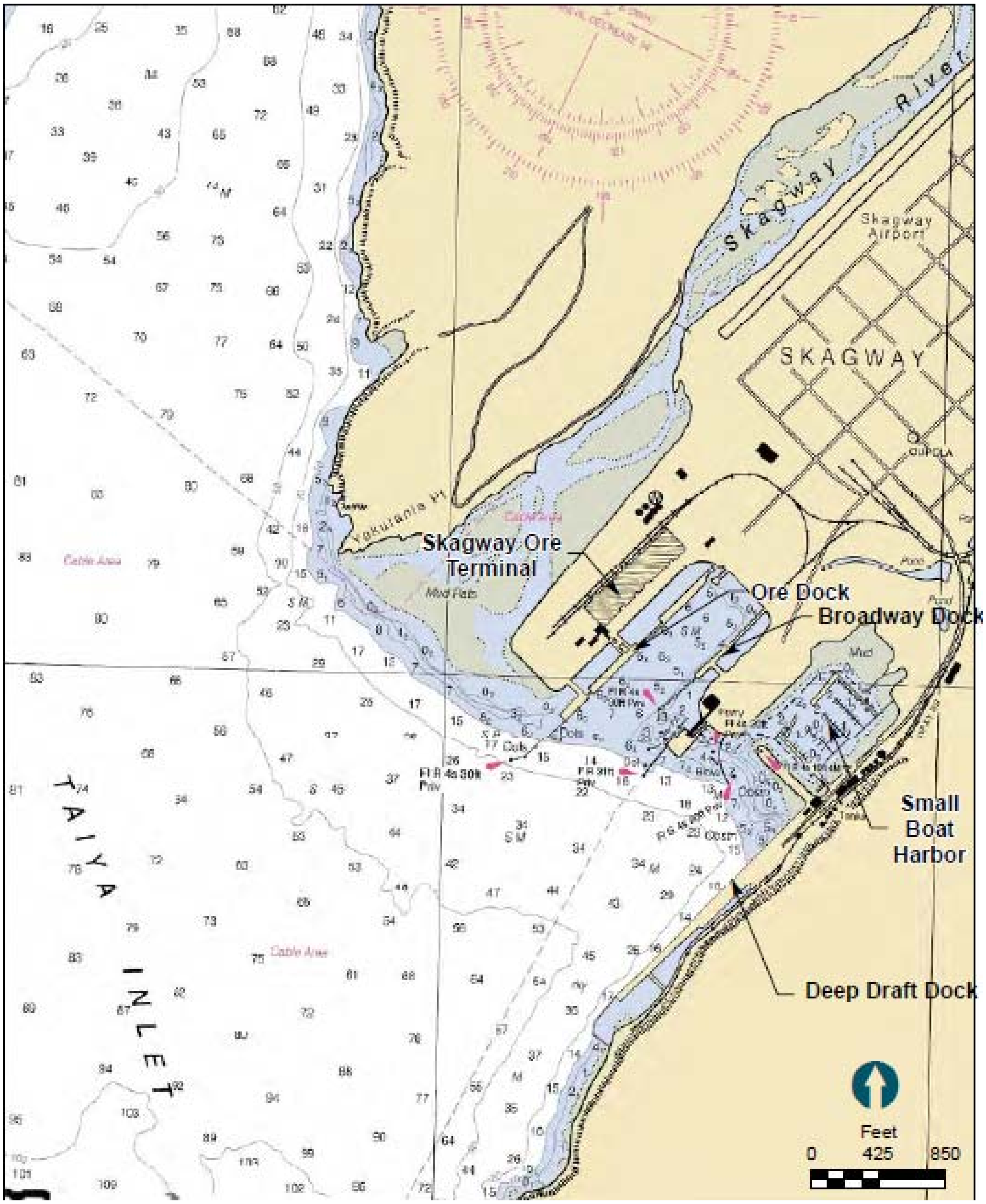


Figure 1: Site Overview Map (adapted from Anchor QEA 2015). NOAA 2015 Chart #17317.

2.0 REVIEW OF EXISTING INFORMATION

2.1 Background and Dredging History

Within a coastal environment the rate of change of sediment is dependent on the amount of sediment brought into the system versus the amount leaving the system. Inputs, outputs and changes in sediment storage comprise the sediment budget for a finite morphological unit which reflects the natural erosion and accretion patterns as well as the artificial removal or addition of sediment due to dredging, disposal, sediment nourishment or marine construction. A review of the harbor history and dredging and construction activity is necessary not only to account for gains and losses of sediment to the harbour but also to provide context for the relative scale of natural and artificially induced changes in the system.

The Skagway Ore Terminal harbor is located adjacent to the mouth of the Skagway River, where it empties into the Taiya Inlet, which opens into the Lynn Canal, a deep glacial fjord. The harbor was first constructed in the early 1900's and existed in various configurations until mid-century. In the 1960's the Municipality of Skagway constructed a rock groyne over the Skagway tidal flats and river delta and began dredging the harbor between the Skagway River and the State Ferry Dock. A 1959 aerial photograph of river mouth and ore terminal basin is shown in Figure 2, with the outline of the present-day ore terminal traced in yellow. The photo illustrates that the ore terminal basin is constructed in the location of a former delta environment characterised by braided distributary channels and inter-channel bars. In 1969, the Skagway Ore Terminal was constructed and leased to WP&YR to load bulk carriers and berth cruise ships. Ore was loaded onto bulk carriers via open conveyor over the ore dock until 1988. Metal contamination exists within the basin sediments and Taiya Inlet due to the ore loading operations. The following is a timeline of notable recent events in the facility history:

- 1990: The Broadway Dock was built for cruise ships.
- November 3, 1994: An underwater slide destroys the deep draft railway dock and causes wave generated damage about the harbor. Pre and post surveys show an increase from 9 m to 15 m (30 ft to 50 ft) in depth in front of collapsed dock.
- 1995: Dredging of the east basin near the Broadway Dock resulted in a loss of many of the fines in this area (Dames and Moore 1995). The dredging elevation is not specified.
- 1999: Dredging of the east basin near the Broadway Dock to 11.3 m (37 ft) below mean lower low water (MLLW) (PND 1999).
- 2005: Broadway Dock enlarged to accommodate bigger ships (Gartner Lee 2006).
- 2005: Dredging of the eastern portion of the basin to 11 m (36 ft) below MLLW (PND 2005).

Figure 3 shows the present configuration of the Skagway Ore Terminal harbor. The Ore Dock and terminal is located to the left in the photo and the Broadway Dock is located to the right. The harbor basin is approximately 208 m (682 ft) in length and 204 m (669 ft) wide.

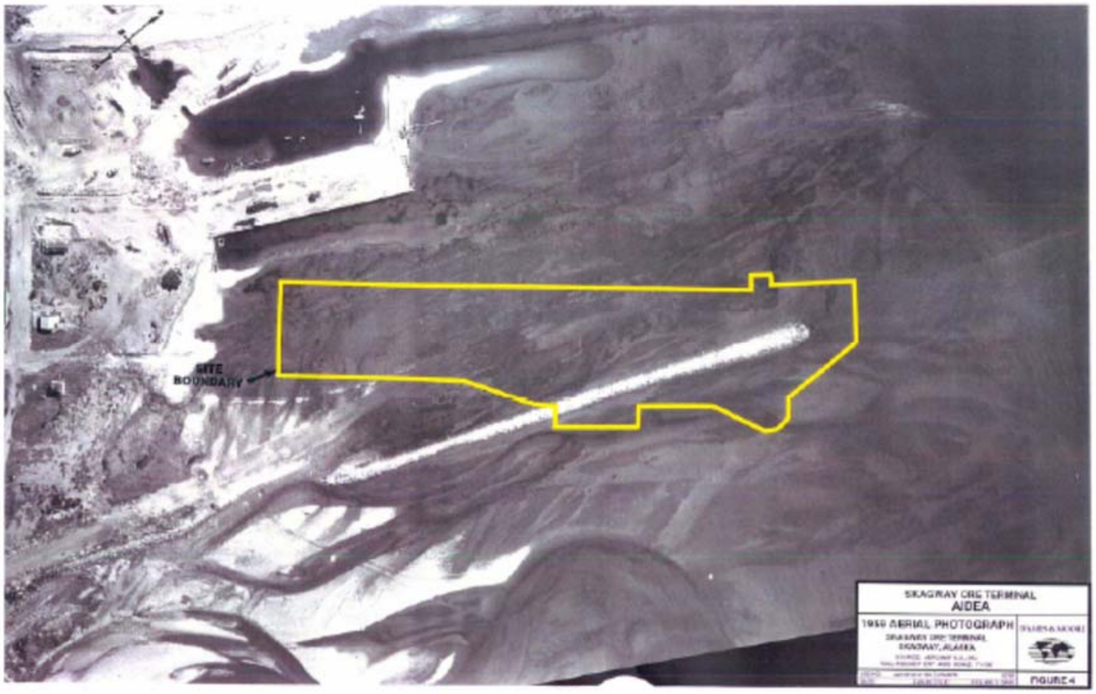


Figure 2: Aerial photo of the Skagway River delta in 1959. An outline of the future ore terminal footprint is traced in yellow (Dames and Moore 1995).

Figure 3: View of the Skagway Ore Terminal harbor. Image source: https://alaskafisheries.noaa.gov/mapping/szflex/

2.2 Sediment Characterization Review

Numerous studies have been completed in and around the harbor to document the metal contamination from ore loading operations. Several of these studies have included assessments of the physical characteristics of the sediment including grain size analysis. In general, sampling and coring of the harbor basin sediment consistently shows the presence of fines and evidence of silt accumulation over time especially near the ore terminal. Relatively high percentages of gravelly sandy sediment are also consistently present. These are interpreted as relict deposits which reflect the historical high-energy fluvial and deltaic environment which pre-dates the construction of the harbour basin. The following is a summary of previous sediment characterization studies:

- SRK (1989)
  - Stratification within core samples (gravity and vibracore) indicates the contaminated sediment is greater prior to activities being suspended in 1982 than what has accumulated since 1986 when operations resumed.
  - Surface sediments "naturally covered by additional natural silt sediment".
  - The process of sedimentation is covering the contaminated harbor bottom sediments, it is anticipated that the potential impact of the lead and zinc levels will reduce with time.
  - No grain size analysis was completed.
- Tetra Tech (1990)
  - Grab samples were collected using a 0.1 m^2 Van Veen sampler.
  - Samples collected in the harbor basin ranged in fines content from 22.9% to 61.2%.
  - Grain size analysis indicated a general trend of coarser surficial sediment along the east side of the basin and finer sediment near the ore terminal (west side).
  - Hypothesizes that coarser material was deposited by Pullen Creek along the east side of the basin.
  - Inside the small boat harbor was noted to be a depositional environment.
- Dames and Moore (1995)
  - Samples were collected with a dart core sampler and a modified 0.1 m^2 Van Veen sampler.
  - Deep, fine-grained silty sand or sandy silt were found closest to Ore Dock.
  - Clean, sandy silt were located further from the Ore Dock.
  - Poorly sorted gravels and sand, closer to the Broadway Dock, were likely a result of recent dredging which removed many fines in this area.
- PND (1999, 2005)
  - Sampling near the Broadway Dock found 7.8% to 33% fines and was characterized as sandy with gravel lenses.
  - Dredged material was coarse sand with gravel.

- Gubala (2007)
  - Completed a bathymetry and sub-bottom profiler (SBP) survey of the harbor basin and adjacent river mouth. Sediment cores were collected by divers because gravity coring techniques were unsuccessful due to the consolidated and heterogeneous nature of the sediments.
  - The divers reported interspersed cobble and small rock lying atop the sediments throughout the ore terminal basin.
  - The presence of cobble and rock at the sediment surface, combined with the lack of flocculent material and a highly packed sediment sequence is reported to be highly indicative of an erosional environment.
  - SBP data indicates a hard-packed surface in much of the basin, however sediment layering was interpreted from data at the outer portion of the basin above the slope into Lynn Canal.
  - Minimal evidence exists of sedimentation at the river delta in the SBP data, except on the eastern section (nearest the basin).
  - Accumulated delta material shunts sediment-laden water directly to the east toward the terminus of the ore terminal.
- Tetra Tech (2008)
  - Grab samples were collected using a 0.1 m^2 Van Veen sampler.
  - The top 2 to 4 inches of the harbor and outer harbor samples were dominated by fine sand and silt, all samples contained a minimum of ~50% up 90% fines.
  - 1 to 2 inches of relatively clean silts were found to be deposited on top of more contaminated sediments near the Ore Dock.
- Anchor QEA (2015) and Hart Crowser (2015)
  - Twenty 15 foot vibracore samples were obtained within the ore terminal basin and nine 100 foot geotechnical borings.
  - The samples were consistent with those expected for a high-energy fluvial and tidal environment. Typically gravelly sand in the upper 4 ft with 29% to 37% gravel content, 55% to 60% sand (fine to coarse) and 6% to 7% fines.
  - In a few samples, near the Ore Dock, a higher percentage of fines (15% to 63%) were present in sediment at 0 to 4 ft below the mudline. In those cases the lithology is more representative of a silty sand with gravels.
  - From 4 to 12 feet below the mudline the lithology is very gravelly sand.
  - Figure 4 shows a generalized cross-section from the geotechnical investigation in the harbor. A small lens of silt sediment is indicated near the Ore Dock.

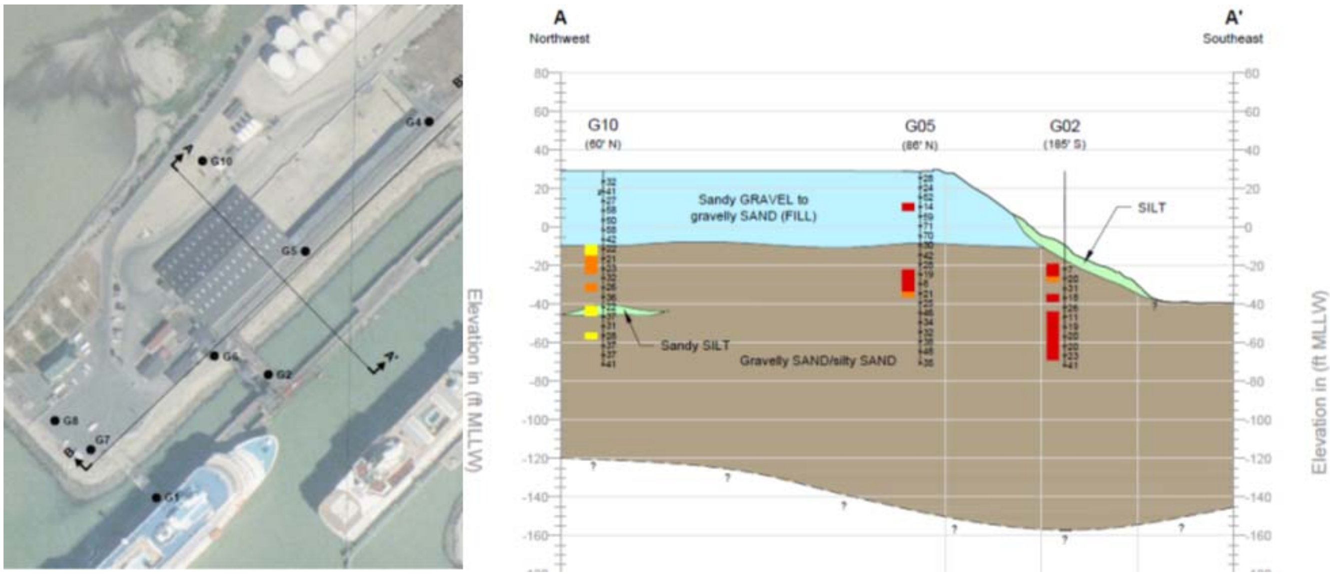


Figure 4: Generalized cross-section from a 2015 geotechnical investigation. The plan map is shown on the left (Hart Crowser 2015).

2.3 Water Levels

Tides in Skagway are mixed semi-diurnal (two highs and two lows per day). Characteristic tidal planes for the Skagway, AK National Ocean Service (NOS) tide station (#9452400) for the tidal epoch from 2007-2011 are reproduced in Table 1. The tide station is located on the Ore Dock at 59° 27.0' N and 135° 19.6' W. Elevations are referenced vertically above MLLW in feet and meters.

Table 1: Characteristic Tidal Planes at Skagway, AK (#9452400) (NOAA NOS 2016).

Characteristic Tidal Reference	Elevation (ft, MLLW)	Elevation (m, MLLW)
Highest Observed Water Level[1]	26.47	8.07
Mean Higher High Water (MHHW)	16.73	5.10
Mean High Water (MHW)	15.73	4.79
Mean Sea Level (MSL)	8.81	2.69
Mean Low Water (MLW)	1.62	0.49
Mean Lower Low Water (MLLW)	0.00	0.00
Lowest Observed Water Level[2]	-6.45	-1.97

[1]observed on 10/22/1945
[2]observed on 12/14/2008

A sea level trend analysis for 1945 to 2015 at the Skagway tide station indicates a decreasing sea level at a rate of 17.59 mm (0.69 inches) per year (NOAA NOS 2016). Figure 5 shows the mean sea level trend measured at the tide station from 1944 to 2016. The decreasing sea level is typical for southeast Alaska resulting from isostatic glacial rebound from the loss of glacial ice over the last 200 years (USGS 2012).

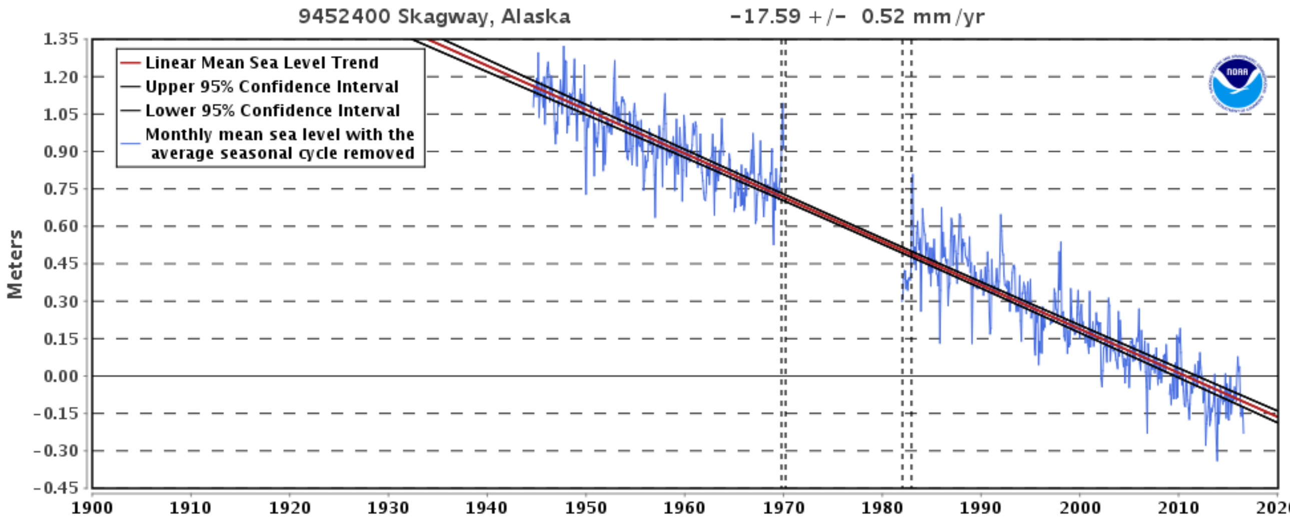


Figure 5: Mean sea level trend with the regular seasonal fluctuations removed. Image source: NOAA NOS (2016).

2.4 Bathymetry

Bathymetric surveys of the ore terminal harbor basin and vicinity were reviewed and used in a bathymetry change analysis to identify potential sedimentation trends within the basin. The following is a list of known hydrographic surveys near the basin:

- NOAA H06945 1943 survey (single beam, only partial coverage –not used in analysis)
- NOAA F00358 1990 survey (single beam)
- NOAA F00416 1995 survey (single beam, post submarine landslide)
- NOAA 1998 H10806 survey (single beam – not used in analysis)
- NOAA H10972 2000 survey (multi-beam)
- Gubala Consulting 2007 (single beam – data not provided)
- Terrasond October 28, 2014 survey (multi-beam - requested raw data)

All of the NOAA hydrographic surveys were provided in meters below MLLW. Raw data from the 1990, 1995, and 2000 surveys were imported into the computer software Surface-water Modeling System (SMS), cleaned, and gridded for comparison to each other. Figure 6 through Figure 9 show the bathymetric surface maps for 1990, 1995, 2000, and 2014. Figure 10 through Figure 12 show bathymetric difference maps between 1995 minus 1990, 2000 minus 1990, and 2000 minus 1995, respectively. Warmer colors in the difference maps indicate accretion, while colder colors indicate erosion. Figure 13 shows four cross-section comparison plots of the 1990, 1995, 2000, and 2014 surveys. Cross-sections from the 2014 survey were manually digitized from the bathymetry surface contour map for the purpose of comparison to the previous surveys because the raw data was not available.

The following observations were made from the bathymetry maps:

- 1990 (Figure 6): The 1990 survey shows a relatively flat seabed in the basin with elevations between 13 m and 13.5 m (42.6 ft and 44.3 ft) below MLLW with the exception of the east basin near the Broadway Dock where the seabed is shallower and approaches 9 m (29.5 ft). Seaward of the basin, the seabed drops off steeply from 15 m (49.2 ft) down to 30 m (98.4 ft) below MLLW into Lynn Canal.
- 1995 (Figure 7): The 1995 survey shows a similarly flat seabed and elevations relatively consistent with the 1990 survey in the west side of the basin. The east basin near the Broadway Dock is deeper with elevations between 11 m and 12 m (36.1 ft and 39.3 ft) below MLLW, likely a result of dredging in 1995. The dredging elevation in 1995 was unspecified the Dames and Moore (1995) report.
- 2000 (Figure 8): The 2000 survey shows a relatively flat seabed across the entire basin between 11 m and 12.5 m (36.1 ft and 41.0 ft) with a few shallower areas near the Broadway Dock. Dredging occurred in 1999 but only at the head of the basin near the Broadway Dock. The dredging elevation was reported to be 11.3 m (37 ft) below MLLW.
- 2014 (Figure 9). The 2014 survey was a high-resolution multi-beam survey and includes the slopes underneath both docks up to approximately 3 m (10 ft) MLLW. This survey shows the basin elevations ranging from approximately 11 m to 12.5 m (36.1 ft to 41.0 ft) below MLLW. A few scour-like depression features exist in the basin floor that are approximately 1 m to 2 m (3.3 ft to 6.6 ft) deep and are up to 50 m (160 ft) long. These depression features may be the result of propeller scour based on their location, size and shape.

The bathymetric difference maps and cross-section plots extracted from each bathymetry map illustrate the trends in bathymetry change between 1995 and 2014. The results show a progressive decrease in depth of 1.0 m and 1.5 m (3.3 ft and 5.0 ft) in the west side of the basin between 1990 and 2014 and 2 m to 3 m (6.6 ft to 10.0 ft) increase in depth on the east side of the basin is observed in the 1995-1990 difference map. The increase in depth on the east side of the basin is consistent with documented dredging. The 1995-1990 difference map also shows what could be a possible scour hole off the southwest end of the Broadway Dock.

The comparisons are used only to identify general trends in the seabed elevation (relative depth). The decrease in depth (shallowing of the basin) observed between bathymetry surveys cannot be completely attributed to deposition of sediment because of errors attributed to the comparison and documented vertical land motion in Skagway as follows:

- Byrnes et al. (2002) estimate that modern horizontal positioning and vertical measurement equipment can minimize error of an individual bathymetric survey to 0.15 to 0.30 m and overall error of the comparison of bathymetric surveys from 0.10 m to 0.40 m (0.4 m is reasonable error for the level and type of survey comparison conducted).
- Positive vertical land motion due to isostatic rebound in the Skagway region accounts for approximately a 0.45 m increase in the seabed elevation over 25 years from 1990 to 2015.

After accounting for these two factors, the deposition of sediment in the west portion of the basin could range from approximately 0.4 m to 0.9 m (1.3 ft to 3.0 ft).

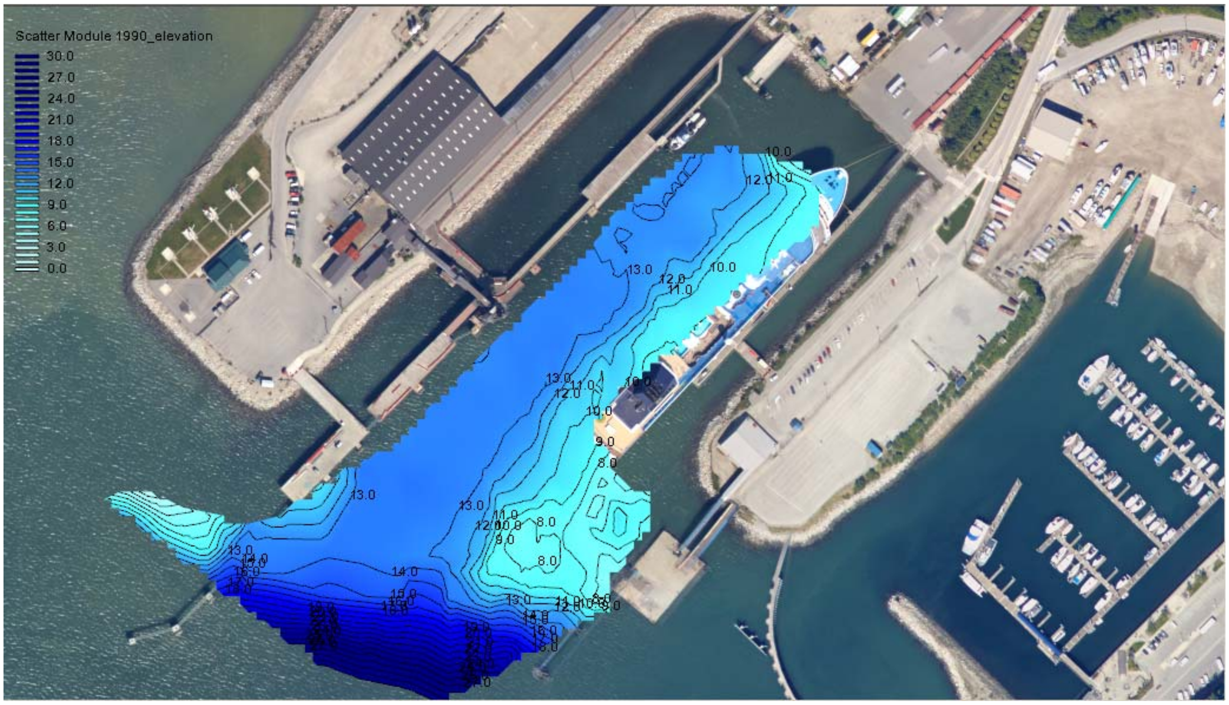


Figure 6: 1990 Bathymetric surface map, seabed elevation in meters below MLLW.

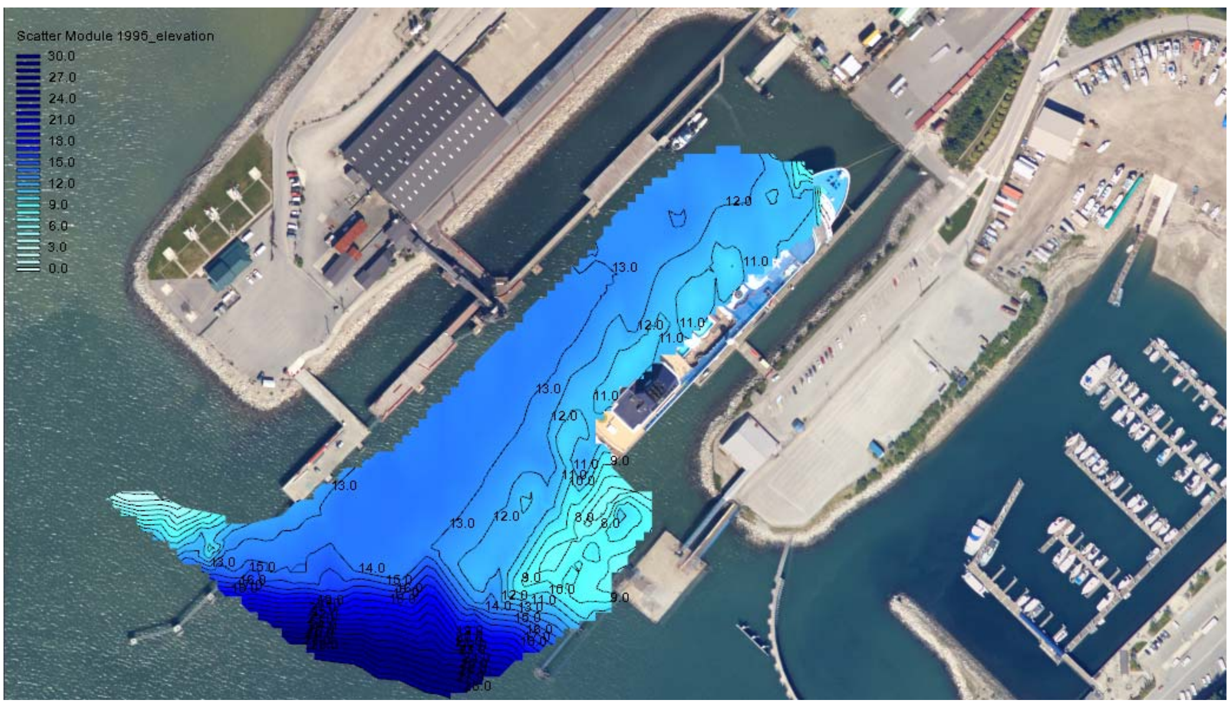


Figure 7: 1995 Bathymetric surface map, seabed elevation in meters below MLLW.

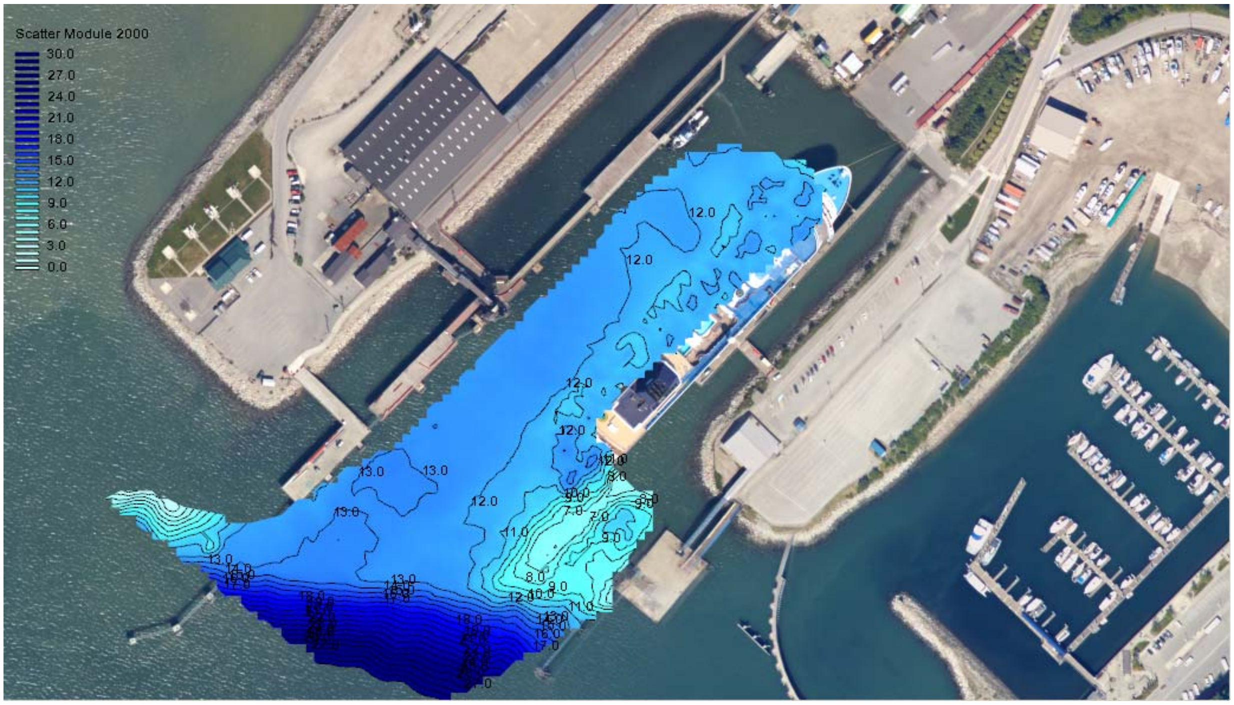


Figure 8: 2000 Bathymetric map surface, seabed elevation in meters below MLLW.

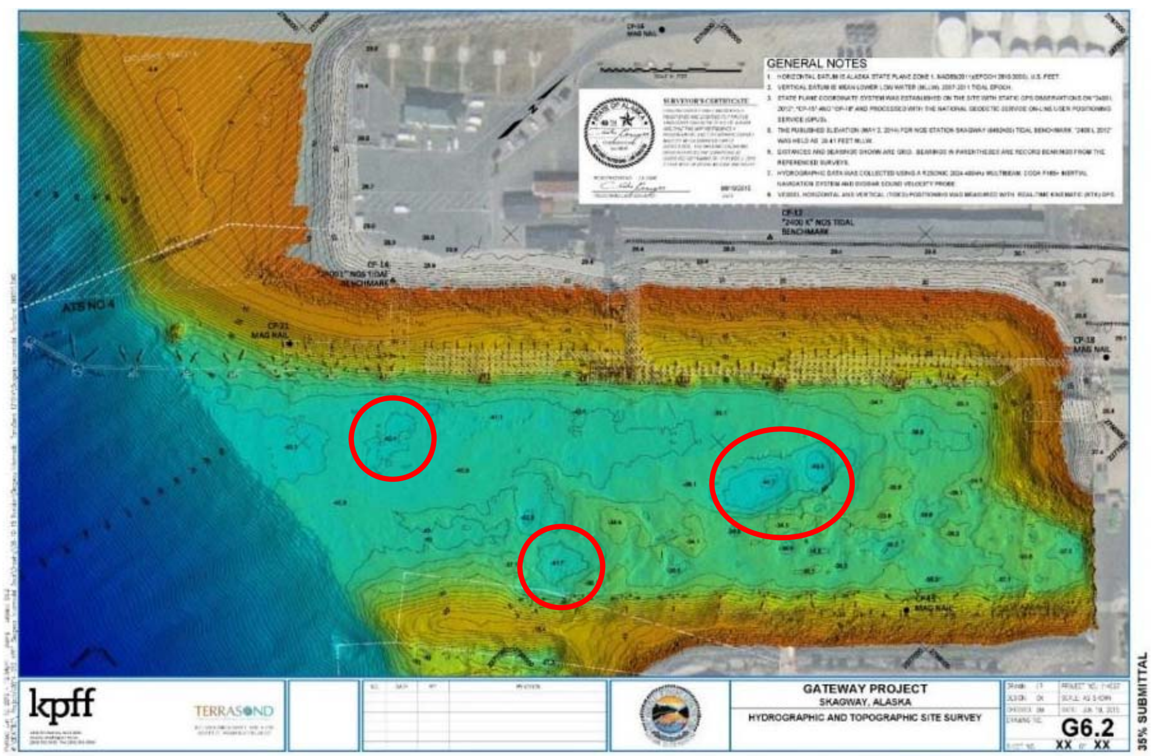


Figure 9: 2014 Bathymetric surface map, seabed elevation in feet below MLLW (KPFF 2015). Scour-like depression features are circled in red.

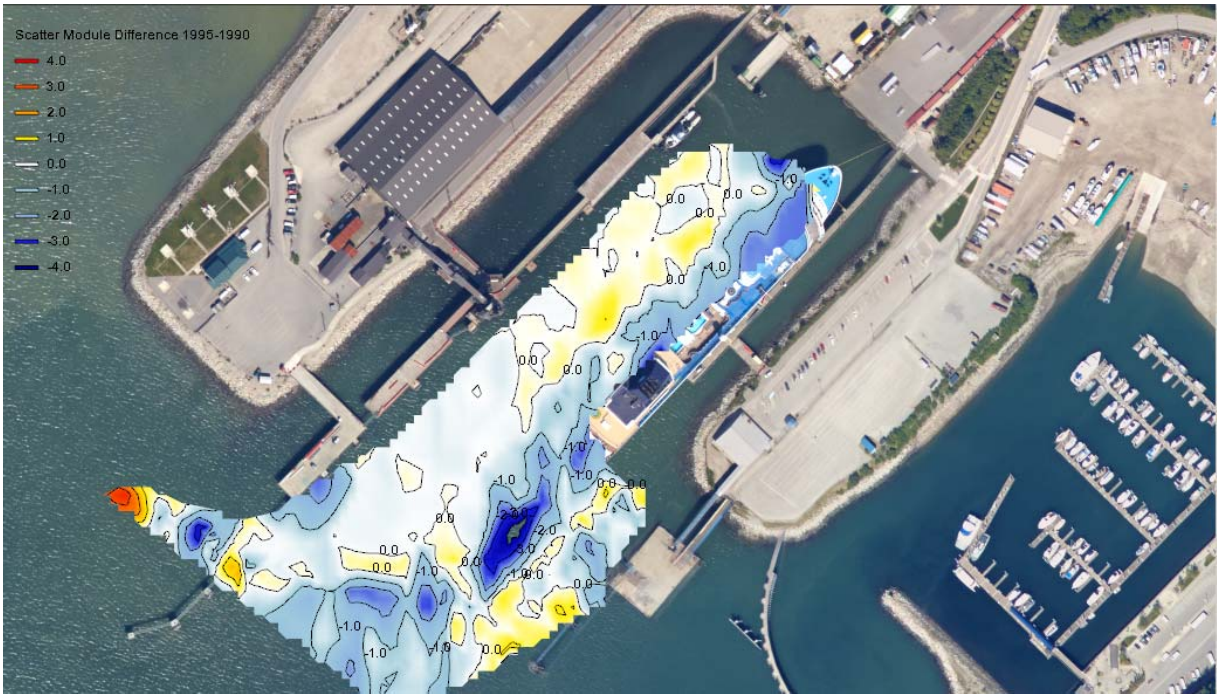


Figure 10: 1995 - 1990 Bathymetric difference map, in meters. Warmer colors indicate accretion, colder indicate erosion.

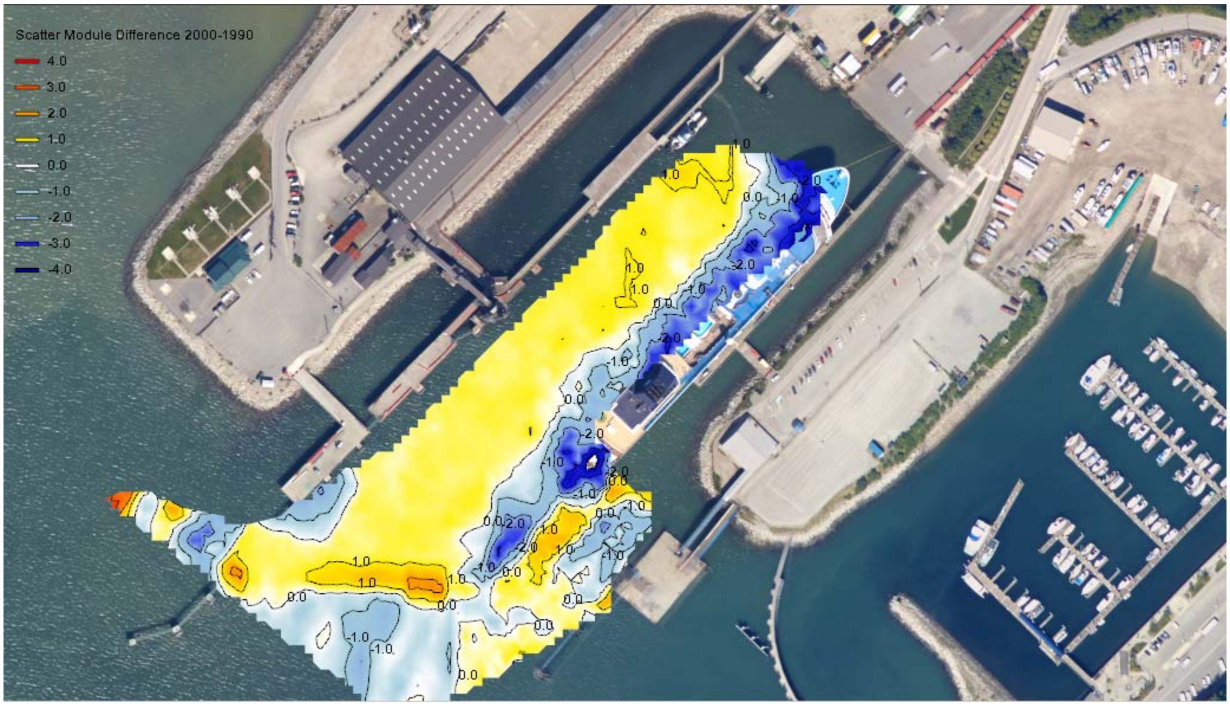


Figure 11: 2000 - 1990 Bathymetric difference map, in meters. Warmer colors indicate accretion, colder indicate erosion.

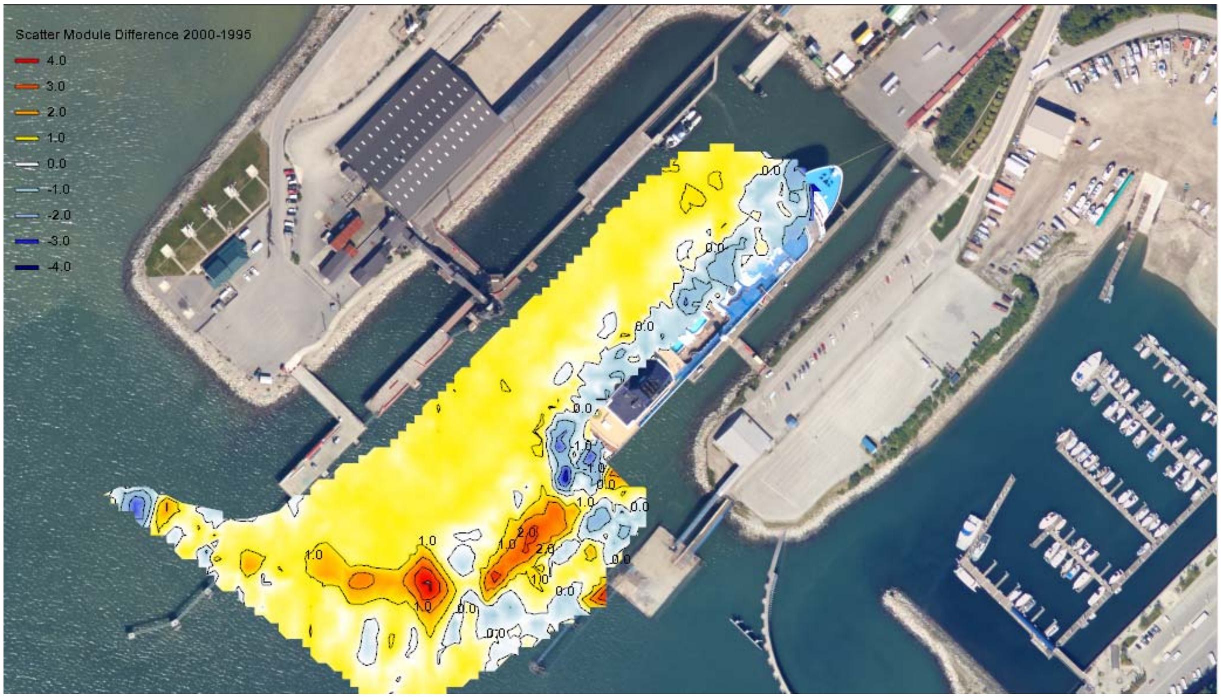
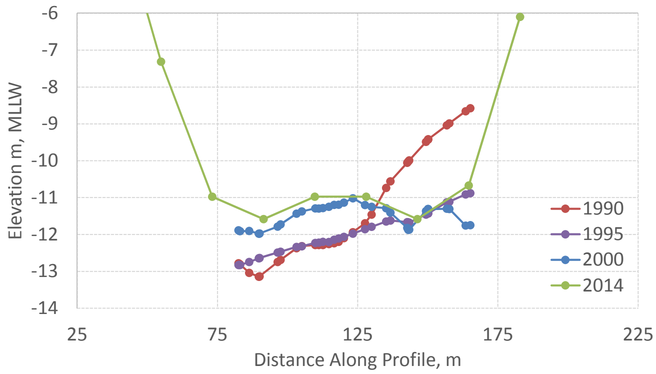
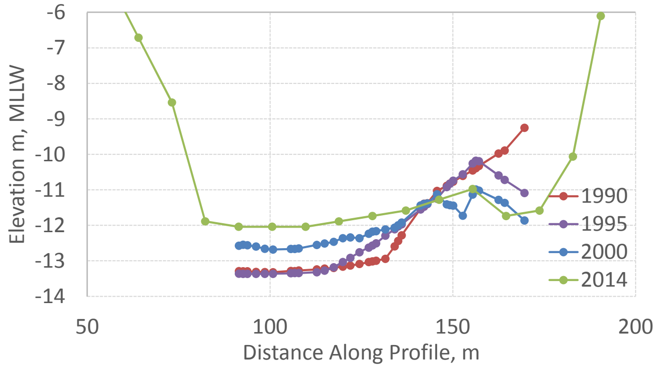


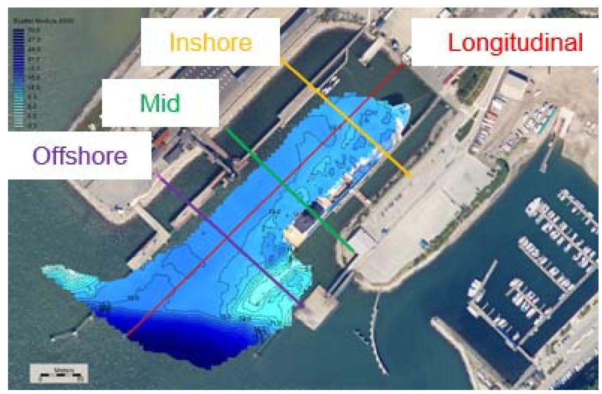
Figure 12: 2000 - 1995 Bathymetric difference map, in meters. Warmer colors indicate accretion, colder indicate erosion.

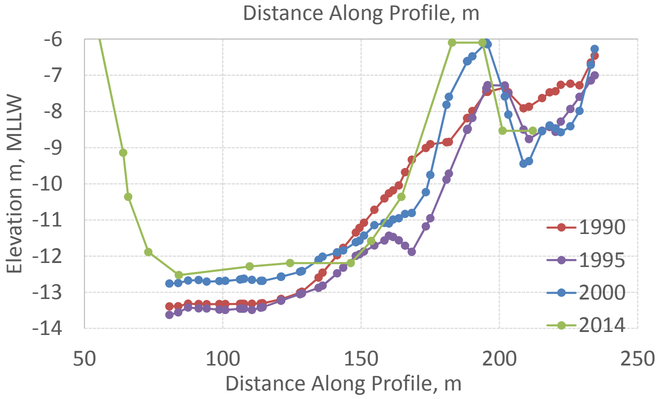


Inshore

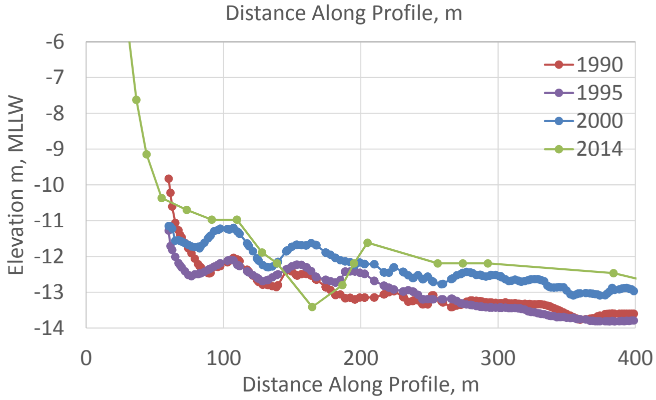


Mid





Offshore



Longitudinal

Figure 13: Comparison of four cross-section from each bathymetry surface.

2.5 River Flows

2.5.1 Skagway River

The Skagway River measures 30.4 km (19 miles) from the Warm Pass tributary and flows southwest into Taiya Inlet and Lynn Canal (Buzzell 2004), entering Taiya Inlet adjacent to the ore terminal harbor. The lower 5 miles of the river are characterized by braided channels separated by gravel bars and terraces. Figure 14 shows a photograph of the river mouth in 1929 prior to the modern configuration of the harbor. The braided river delta encompassed most of the land area at the mouth, including what is now the ore terminal harbor. The construction of the terminal basin would have prevented any further migration of braided channels across the basin and therefore permanently cut off the basin to most or all coarse bedload transport from the Skagway River.

Peak discharges on the Skagway River occur from approximately May to November and the 100-year flood event is estimated to be 38,000 cubic feet per second (cfs) (PND 2016). Eight flood events above 13,000 cfs have occurred over the last 120 years, with the most recent event occurring in 1981 (PND 2016). The sediment plume at the mouth of the river is well defined in photographs in Figure 15 and Figure 16, illustrating the large potential source of fine sediment (fine silts and clays) for deposition in and near the ore terminal basin. In the latter photograph, the fresh water plume is trapped by the saltwater wedge on a flooding tide (approaching slack tide), a potential mechanism for sediment deposition in the ore terminal basin.

Figure 14: The Skagway River mouth and town of Skagway, June 22, 1999 (Buzzell 2004).

Figure 15: May 21, 2004 aerial photo of the Skagway River mouth and sediment plume (USACE 2008).

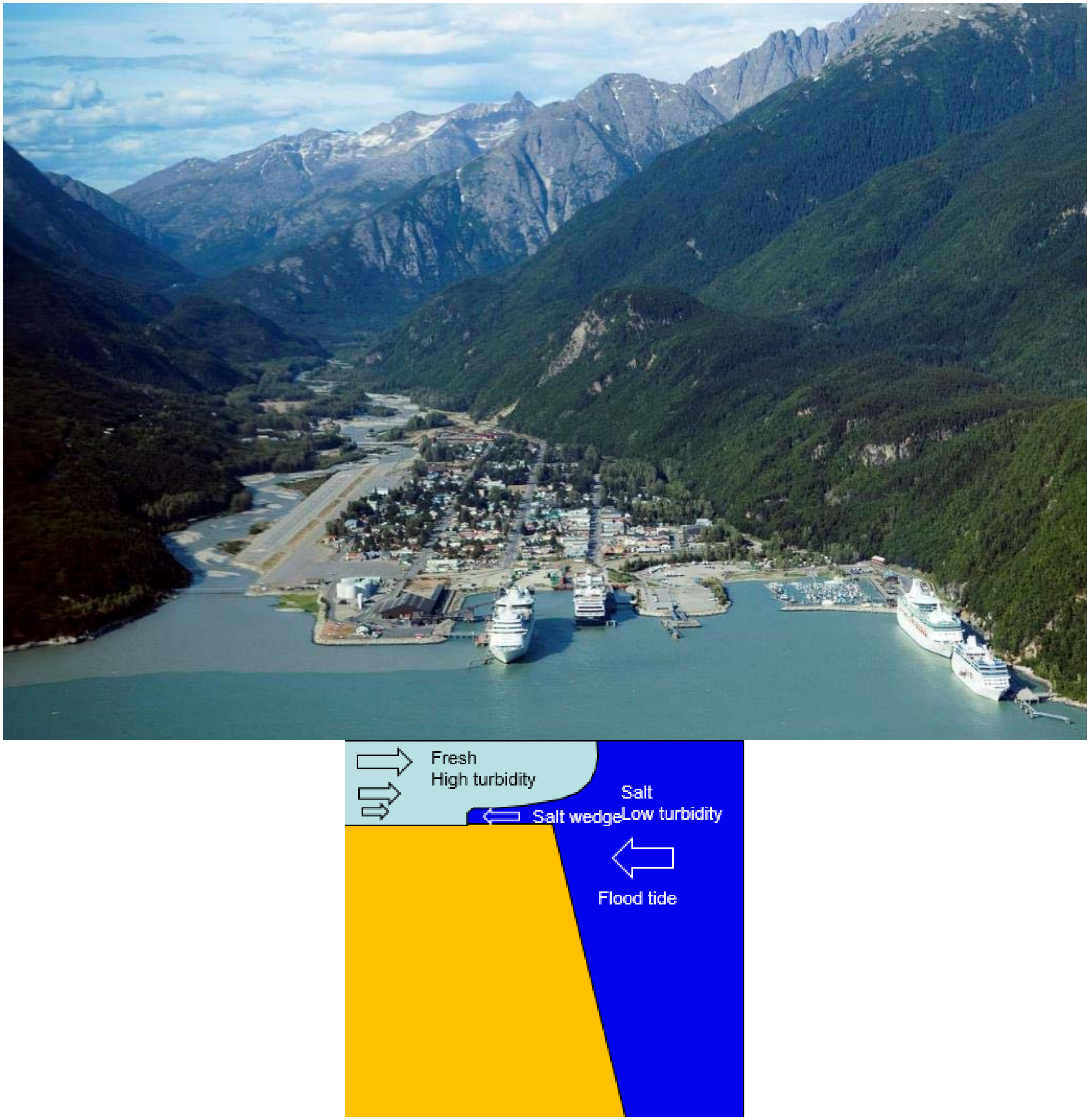


Figure 16: July 13, 2009 aerial photo of the Skagway River mouth and sediment plume. The cartoon illustrates the trapping and deflection of the silty fresh water plume by a flooding tide as can be seen in the photo

2.5.2 Pullen Creek

Pullen Creek is a low-gradient spring-fed creek that is approximately 2.4 km (1.5 miles) long running along the northeastern edge of downtown Skagway and directly into the ore terminal basin (Figure 17). The creek receives additional water from the Alaska power and Telephone (APT) Dewey Lakes Hydroelectric plan (ADEC 2005). Discharge below the APT input ranges from <2.0 cfs to 40 cfs depending on whether APT is discharging into the creek.

The creek streambed cuts through floodplain deposits from the Skagway River and is primarily composed of gravel, cobble, and boulders. A few sections of exposed bank lacking vegetation may be prone to erosion and transporting fines downstream at higher flows (ADEC 2005).

Figure 17: Pullen Creek, highlighted in blue (ADEC 2005).

2.6 Wind and Waves

2.6.1 Wind Climate

Historical hourly wind records were obtained for the Skagway Airport meteorological station, the closest available station to the project, (station ID: WBAN 25335). The Skagway Airport station is located approximately 0.5 km (0.3 miles) northeast of the ore terminal at 59.456° N, 135.324° W at an elevation of 6.1 m (20 ft) above mean sea level (msl). Figure 2 shows a wind rose based on the data collected at Skagway Airport from 1973 through 2016 (44 years). In general, the winds are bi-modal with winds typically arriving from the southwest or from the northeast. The most prevalent winds are from the south-westerly sector. Figure 3 shows wind roses by month for the station. Prevailing winds from April through October are from the southwest, whereas from November through March northeast winds are prevalent but southwest winds are also present. Wind speed statistics were calculated for the station and the results are shown in Table 2. Data were filtered for zero values and missing records. The maximum wind speed recorded at the station over the 44 year period of record was 67.8 knots.

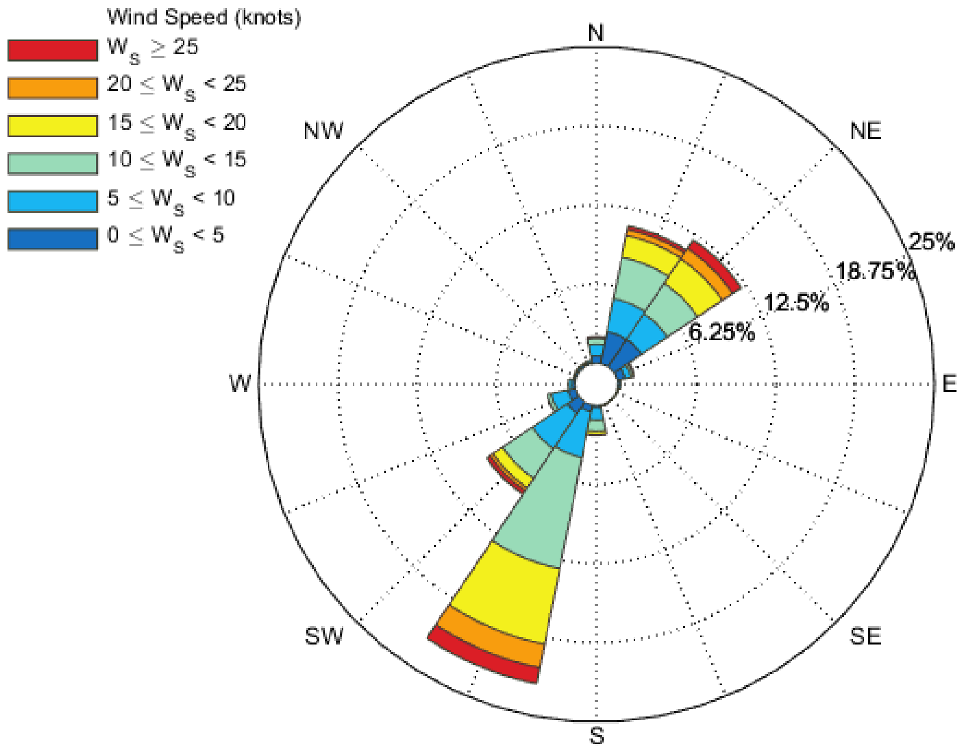


Figure 18: Wind rose for Skagway Airport from 1973 to 2016.

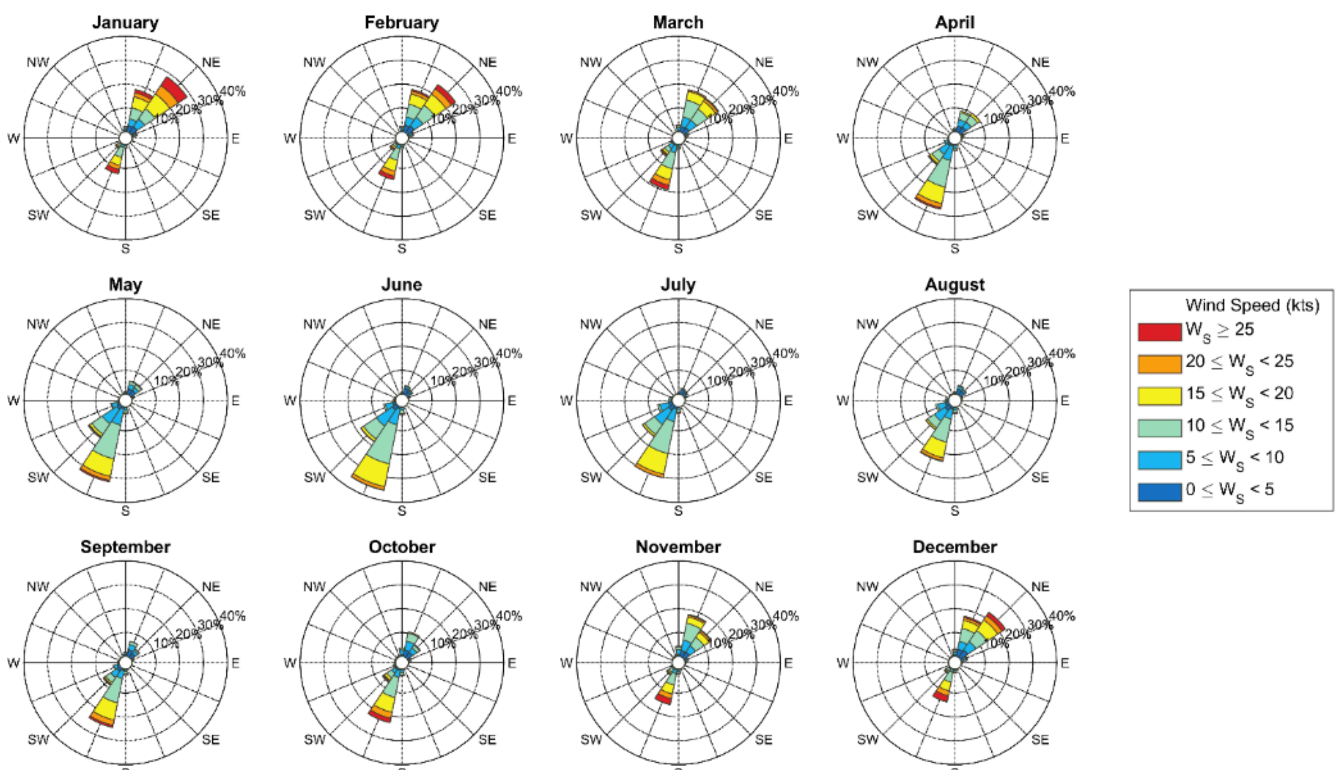


Figure 19: Monthly wind roses from Skagway Airport from 1973 to 2016.

Table 2: Wind Speed Statistics for Skagway Airport (1974-2016) in Knots

Min	1%	5%	25%	Median	Mean	75%	95%	99%	Max	Std
0.9	2.6	2.6	7.0	12.2	12.2	15.6	24.3	29.5	67.8	6.5

Minimum (Min), Maximum (Max), Standard Deviation (Std), 99% = 99th percentile, No. Valid = number of valid measurements, % Valid = percentage of valid data relative to total dataset

A peaks over threshold (POT) extreme value analysis (EVA) was carried out using wind speeds recorded at Skagway Airport to determine wind speeds for a number of return periods. The POT analysis involved (Goda, 1988; Leenknecht et al., 1992):

- Sorting the time series wind data by the predominant north-easterly and south-westerly directional sectors to isolate data associated with different meteorological conditions (i.e. belonging to different statistical parent distributions).
- Identifying peak wind speeds associated with independent storm events, determined based on exceedance of wind speed thresholds (35 knots) and a minimum inter-event duration of 1 hour. This resulted in the identification of 61 wind events for the south-westerly sectors between 1973 and 2016.
- Fitting a variety of extreme value probability distribution functions (pdfs), including the Fisher Tippett Type 1 (FT-1) and Weibull distributions, to the wind events.
- Based on the best fit extreme value pdf, return value wind speeds were extrapolated for return periods ranging from 1 year to 50 years.

Return value wind speeds based on the POT analysis are summarized in Table 3 for the south-westerly directional sector.

Table 3: Extreme Wind Speeds and Associated Return Interval for South-westerly Winds at Skagway Airport (1973-2016)

Return Interval (years)	Wind Speed (knots)	95% Confidence Interval (knots)		
1	35.5	34.3	to	36.8
2	38.0	35.9	to	40.0
5	42.3	38.2	to	46.3
10	46.0	40.0	to	51.9
25	51.4	42.7	to	60.2
50	55.9	44.8	to	67.0

2.6.2 Wind-Generated Waves

No direct measurements of waves and no modelled waves from valid models are available to the study, therefore a wind-wave hindcast was completed using the extreme wind speeds from the wind climate analysis. Wind-waves at the site were estimated using the Automated Coastal Engineering System (ACES) software (Leenknecht et al. 1992) developed by the United States Army Corps of Engineers (USACE) to estimate wind-wave growth over open water and restricted fetches in deep and shallow water. The deep water, restricted fetch condition was used for calculating wind-waves generated over fetches to the southwest of the ore terminal using the wind parameters from Section 2.6.1.

Return value wind speeds for the southwest directional sector at the Skagway Airport (Table 3) were used to evaluate significant wave heights generated along fetches to the southwest of the site (approximately 205 degrees relative to true North). Nearshore wind-generated wave estimates (significant wave height and peak wave period) are provided in Table 4 wind events (with return periods of 1 and 50 years), respectively. Table 4 also provides the maximum bottom orbital velocity for the given wave condition which are useful for assessing the potential for sediment transport.

Table 4: Estimated waves generated by extreme winds blowing over south-westerly fetches.

Return Interval (years)	Wind Speed (knots)	Significant Wave Height, H_s	Peak Wave Period, T_p (seconds)	Maximum Bottom Orbital Velocity (cm/s)
1	35.5	0.85 m (2.8 feet)	3.2	1.5
50	55.9	1.4 m (4.7 feet)	4.0	10.6

2.6.3 Wind-driven Current

A wind-generated surface currents could occur as a result of winds blowing over the fetch to the southwest of the harbor. A commonly accepted rule of thumb for surface current estimation is 3% of the wind speed for long fetches (Wu 1983). For a 1 year return interval wind speed of 35.5 knots, this would result in a surface current of approximately 0.50 m/s (1.6 ft/s). Estimating the bottom current is complicated by other processes occurring in the harbor basin, including wind setup of the water surface, wind-generated waves, and tidal currents, however the bottom current is predicted to be on the order of 1/10th the surface wind-driven current, or approximately 0.05 m/s (0.16 ft/s) (Reid 1957) based on experiments for a bounded channel.

2.7 Tidal Currents

No direct measurements of tidal currents are available for the harbor basin. Gubala (2007) estimated tidal current speeds for the harbour based on the commercial software Nobeltec Tides and Currents. The latter provides an estimate of tidal currents for Skagway based on constituents applicable to the main arm of Taiya Inlet and not specifically the Skagway Ore Terminal. The tidal currents in the Skagway Ore Terminal harbor are constrained by the tidal prism of the basin and therefore a tidal prism analysis of the harbor basin was completed to estimate the maximum tidal velocity at the entrance to the harbor. The tidal prism, Ω, is the volume of water in an estuary or inlet between mean high tide and mean low tide (Hume and Bell 2003). For the Skagway ore terminal basin the tidal prism can be approximated as shown in Figure 20; the difference between MHHW and MLLW, 5.1 m (16.73 ft), multiplied by the cross-section width (W) and average basin length (L). The approximate tidal prism is 216,000 m^3 (7.6 million ft^3). An estimate of the sinusoidal maximum flow through the channel cross-section can then be calculated using the equation from Hume and Bell (2003):

$$Q_{max} = \frac{\pi\Omega}{T}$$

Where T is the tidal period (12.42 hours in this case). The maximum cross-section averaged flow velocity is estimated by dividing Q_{max} by the cross-sectional area. The resulting velocity is less than 0.01 m/s. A similar method for calculating the maximum cross-section averaged flow is presented by Whitehouse et al. (2000) using the maximum rate of change of the tide level. Applying this method to the ore terminal harbor also results in an estimated maximum flow velocity of less than 0.01 m/s.

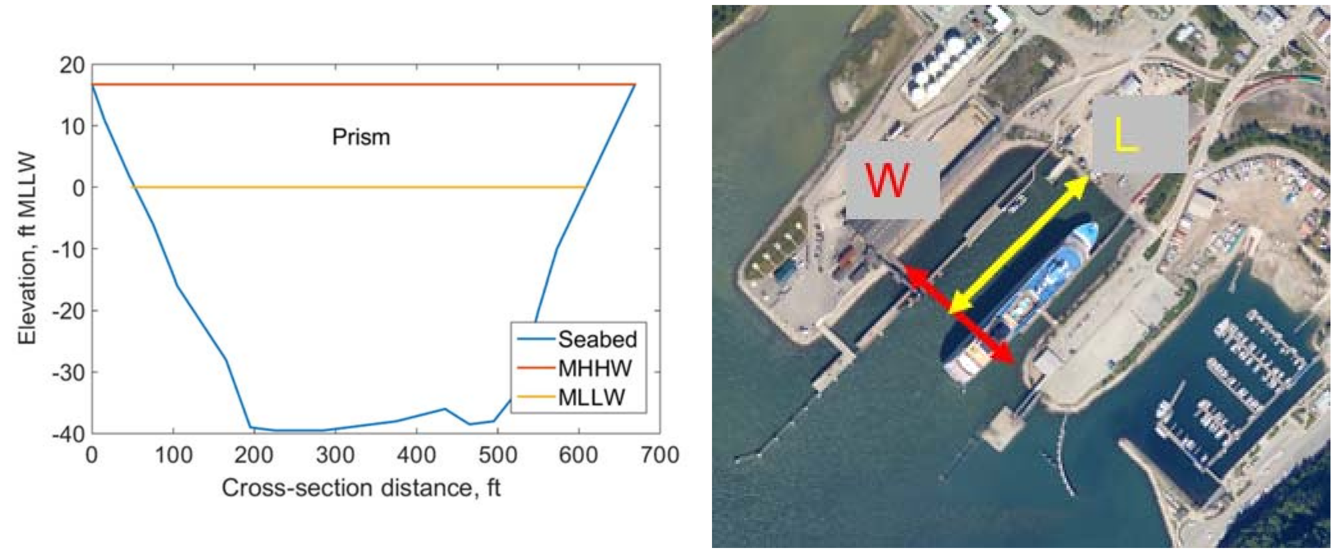


Figure 20: Tidal prism cross-section (left) and plan view (right) for the Skagway Ore Terminal basin.

2.8 Vessel Propeller Wash

No direct measurement of vessel propeller wash is available for the Skagway Ore Terminal, however, Gubala (2007) suggests this might be a mechanism for scouring sediment. The interpretation of the 2014 bathymetry map also suggests that propeller wash could be important in modifying the bathymetry of the basin. Therefore, Golder conducted an analysis of vessel propeller wash to determine their potential to re-suspend and re-distribute bed sediments.

Bulk ore carriers and cruise ships are the primary vessels making ports of call to the Ore Dock and Broadway Dock. The Southeast Alaska Vessel Traffic Study (NUKA 2012) found that in 2011 and 2012 the one week peak-season cruise ship port calls in Skagway was 22 and ore bulk carriers made 6 port calls in 2012.

The ore dock at Skagway can handle Handysize bulk carriers which are typically 35,000 DWT with drafts of 8 m to 9 m and lengths 150 m to 200 m. Typical passenger cruise ships are those in the R-class from Holland America with drafts of approximately 8 m and lengths of 240 m. Ships maneuvering in the harbor is often tugboat-assisted.

A vessel propeller wash analysis was completed using the equation in the CIRIA Rock Manual (2007) for estimating the time-averaged current velocities in propeller jets caused by main propellers. Velocities were estimated for a typical bulk ore carrier / cruise ship operating at 25% power and for a tugboat operating at full power at low tide. The equation uses the vessel draft, propeller dimensions, and power to estimate velocity behind the propeller, $U_{p,}$ as shown in the schematic in Figure 21.

Figure 22 shows a contour map of vessel propeller velocity behind a bulk ore carrier / cruise ship at the seabed. Velocities greater than 1 m/s at the seabed are concentrated in a small area 25 m (82 ft) behind the propeller and 20 m (66 ft) laterally on either side of the propeller. Maximum estimated velocity behind the ore bulk carrier and cruise ship are 1.6 m/s; behind a tugboat maximum estimated velocity is 0.7 m/s.

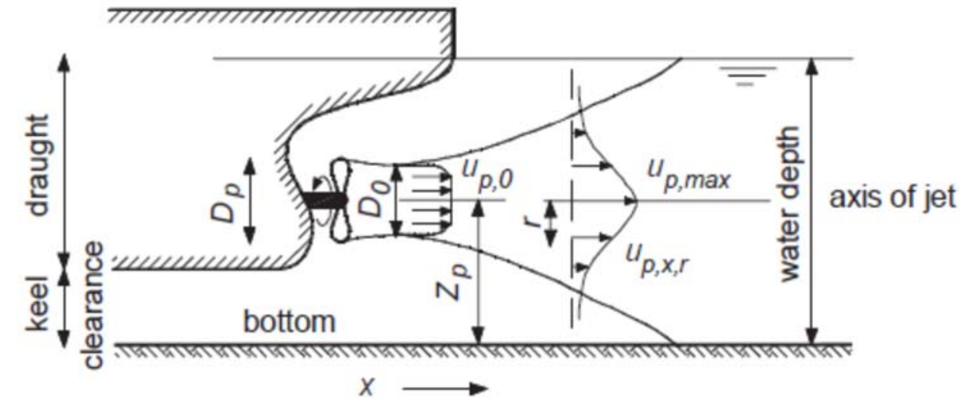


Figure 21: Vessel propeller wash due to a main propeller (CIRIA 2007).

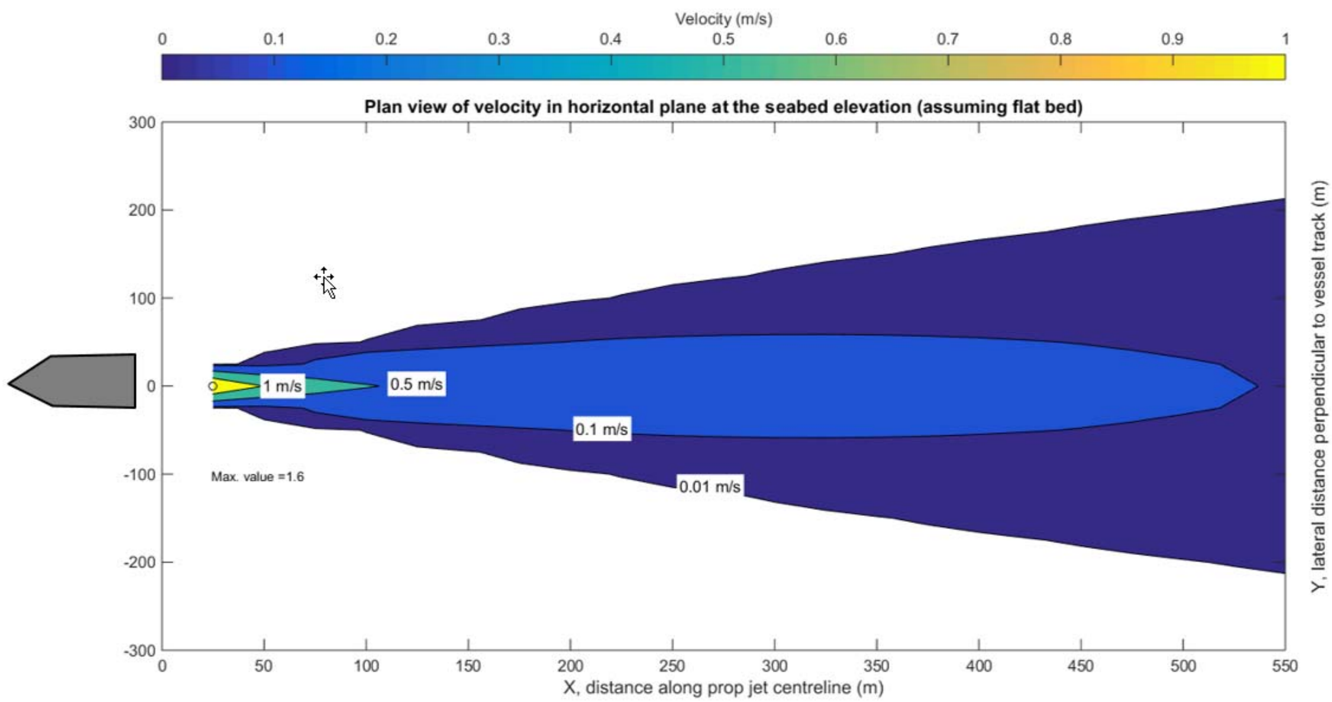


Figure 22: Plan view of vessel propeller wash behind the main propeller for a bulk ore carrier / cruise ship at the seabed elevation.

3.0 PRELIMINARY ASSESSMENT OF COASTAL AND RIVER PROCESSES

The data review identified several natural processes occurring in the Skagway Ore Terminal harbor basin (wind, currents, waves, tides, river flows) which could result in the entrainment, dispersion, and advection of sediment. Additionally, vessel propeller wash scour velocities in the ship basin were identified as a potential mechanism to re-suspend and re-distribute bed sediments. Bed shear stresses for each forcing mechanism were calculated using the methods of Soulsby (1997) and Whitehouse et al. (2000) for prediction of bed sediment entrainment assuming silt and sand sized sediment. A summary of this analysis is provided in Table 5. Figure 23 provides a preliminary conceptual model for sediment processes occurring in the harbor basin. It shows two sources of sediment from the Skagway River and Pullen Creek (likely insignificant) and the natural processes occurring in the basin, including tidal currents, wave flux and storm surge (wind-driven), and vessel propeller wash. Vessel propeller wash and extreme wind-generate waves are possible mechanisms for re-suspension and transport of sediment; tidal trapping of the Skagway River plume (shown in cross-section view) could also advect sediment into the basin.

- One mechanism for erosion in the harbor basin is vessel propeller wash which could suspend gravelly, sandy, and silty sediments. Vessels enter the harbor frequently during the summer season. Evidence of scour-like depressions present in the 2014 multi-beam survey (Figure 9) support the hypothesis that vessel propeller wash from either large bulk ore carriers, cruise ships, or tugboats could cause scour of the bed sediments in the basin. The scale of the scour-like depressions are consistent with the scale of the high velocity region in Figure 22.
- Bottom orbital velocities from extreme wind-generated waves could also be sufficient to suspend sandy and silty sediment in the harbor basin. These events are infrequent and primarily limited to the winter season.
- Sources of sediment to the basin include advection or forcing of the Skagway River plume during the freshet by the following mechanisms: prevailing wind-driven currents from the southwest and flood tide trapping and deflection of the plume. Sediment in the Skagway River plume is likely restricted to fine silts and clays. Pullen Creek is probably an infrequent source of sediment and unlikely to be significant in quantity.

Table 5: Bed sediment entrainment for various forcing mechanisms in the Skagway Ore Terminal basin.

Forcing mechanism	Condition	Sediment entrainment?
Extreme wind-generated waves and storm surges (50 year return interval)	H_s = 1.4 m (4.7 feet); T_p = 4.0 seconds	yes
Typical wind-generated waves (1 year return interval)	H_s = 0.85 m (2.8 feet); T_p = 3.2 seconds	no
Wind-driven current	Max surface current ~ 0.5 m/s (1.6 ft/s) and bottom current in harbor < 0.05 m/s (0.16 ft/s)	no
Tidal currents	V_{max} < 0.01 m/s (0.03 ft/s)	no
Vessel propeller wash, bulk ore carrier / cruise ship	1.6 m/s (5.2 ft/s)	yes
Vessel propeller wash, tugboat	0.7 m/s (2.3 ft/s)	yes

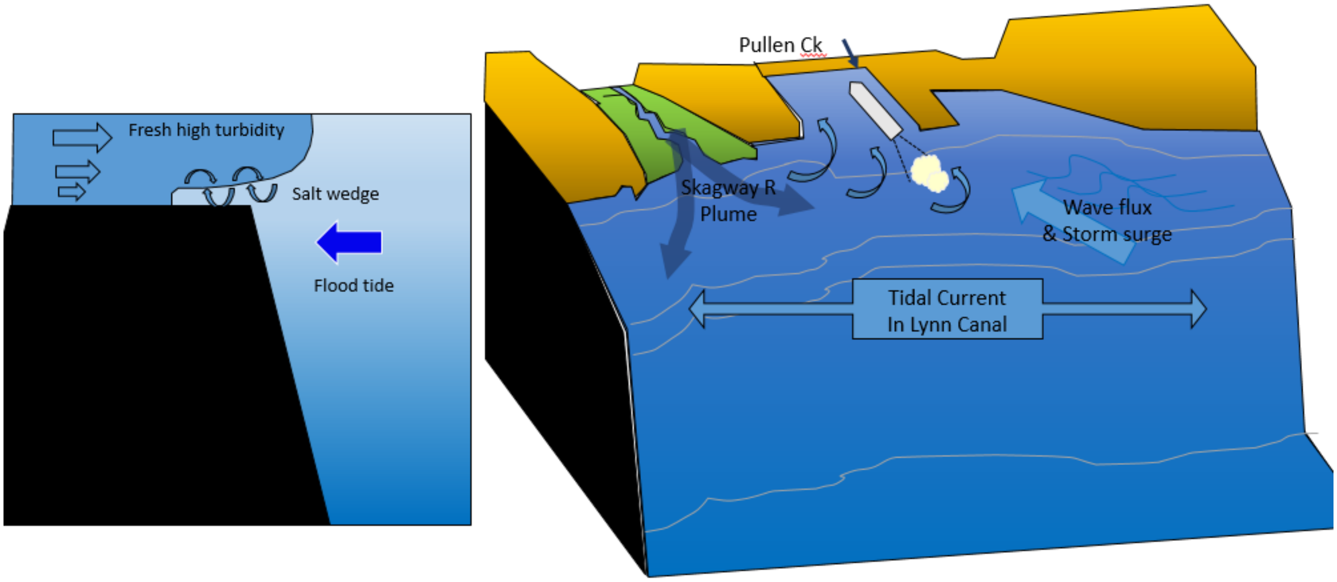


Figure 23: Conceptual model of Skagway Ore Terminal harbor sedimentation.

4.0 SUMMARY AND RECOMMENDATIONS

The characterization of sediments at and beneath the seabed in the Skagway Ore Terminal harbor basin are generally consistent with relict deposits from a coarse clastic braided river and delta distributary and tidal sand flat environment, including evidence of interbedded gravel and sand with some layers of silts (fines) deposited prior to harbor development. The sediment lithology is characteristic of the previously high energy environment where the harbor is now located. However, the current configuration cuts off the harbor from the riverine processes and the resulting environment is typically a low energy and depositional environment.

The bathymetry change analysis, sediment sampling, and sediment coring between 1990 and 2015 are consistent with the pattern and timeline of dredging at the Broadway Dock and progressive accumulation of fine sediment near the Ore Dock. The advection or forcing of the Skagway River plume during the freshet is a mechanism that could explain accumulation of fine sediment near the Ore Dock.

Mechanisms that could result in seabed scour in the ore terminal basin include vessel propeller wash (primarily during summer season) and wave orbital velocities during infrequent extreme storms in the winter season.

Further understanding of the sediment transport in the Skagway Ore Terminal harbor could be improved with the following:

- Direct measurements or calibrated model predictions of sediment transport mechanisms and seabed response including:
  - Vessel propeller wash and related suspended sediment
  - Wave, tide and river currents within and adjacent to the harbor basin
  - Sediment accumulation and scour
- A sediment budget analysis accounting for gains, losses and changes in storage for the Skagway Ore Terminal harbor basin.

5.0 CLOSURE

We trust the information contained in this technical memorandum is sufficient for your present needs. Should you have any additional questions regarding the project, please do not hesitate to contact the undersigned.

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APPENDIX B

Sampling and Analysis Plan for Surficial Sediment Sampling

17 April 2017

STUDY DESIGN AND SAMPLING & ANALYSIS PLAN

Skagway Ore Basin Sediment Assessment

Submitted to:
White Pass & Yukon Route Railway
PO Box 435
Skagway, AK 99840

REPORT

Report Number: 1657231-002-R-Rev1

Distribution:

1 copy - White Pass & Yukon Route Railway
1 copy - Golder Associates Ltd.

Golder Associates

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Purpose of this Document

This document provides a study design and sampling and analysis plan (SAP) to support an ecological and human health risk assessment for the Skagway Ore Terminal (the “Ore Basin”). A brief overview of the historical data is provided to provide context for the proposed study design. The sampling and analysis plan describes the specific data to be collected along with details regarding the proposed sampling methodology and quality assurance / quality control measures.

1.2 Site Description

The Skagway Ore Terminal and other portions of Skagway Harbour are shown on Figure 1. Skagway Harbour lies at the terminus of a deep fjord (Lynn Canal) on the historical alluvial fan of the Skagway River. The harbour consists of a limited near-shore zone with a typical water depth of between 30 and 40 feet (measured from mean low tide) which transitions rapidly to the deeper waters in Lynn Canal (Anchor 2015). The shoreline of Skagway Harbour was established on the historical alluvial fan through a combination of dredging and filling in the early 1900s (Tetra Tech 2008). Substantial changes to the harbour configuration were made during the construction of the Small Boat Harbour (circa 1958), the State Ferry Terminal (circa 1963), and the expansion of the Ore Terminal (circa 1968), all of which involved dredging and use of the dredged material to expand and reconfigure the shoreline (Anchor 2015). A brief summary of historical site activities at the Ore Terminal is provided for further context (Anchor 2015).

- The Ore Terminal portion was leased by White Pass and Yukon Railway (WYPR) from the Municipality of Skagway in the late 1960s and was primarily used for the trans-shipment of ore concentrate from the Faro Mine (Yukon; primarily lead and zinc concentrates) using an open conveyor system between 1967 and 1982.
- Sporadic use of the facility for shipping ore concentrates continued between 1982 and 1997 with a variety of terminal operators, and the conveyor system was enclosed in 1991.
- A concrete dock was added in 2000 to allow the facility to be used by cruise ships, and the historical ore concentrate building was demolished in 2003. A new concentrate building was constructed and has been used for shipment of copper concentrates from the Minto Mine since 2007.
- The terminal is currently operated by Alaska Industrial Development and Export Authority (AIDEA). Infrastructure includes a fuel depot (operated by Petro49) and a container facility (operated by Alaska Marine Lines) in addition to the ore concentrate shipping and cruise ship docking.

1.3 Summary of Historical Information

1.3.1 Sediment Chemistry, Toxicity and Benthic Community Data

A number of investigations have been conducted to obtain information about the environmental quality of surface water and sediment in Skagway Harbour. The locations of historical samples are provided in Figures 2 and 3 and an overview of the types of data collected is provided in Table 1.

Table 1: Types of Data Collected During Historical Investigations in the Vicinity of the Ore Basin

Document	Sediment Chemistry (Surface Grabs / Cores)			Water Chemistry		Toxicity Testing	AVS	Tissue Chemistry	Benthic Community
	Metals	Hydrocarbons	Grain Size	PW	SW				
RWM (1984)	Yes / NA	—	Yes	—	Yes	—	—	Crabs, mussels, sole	Summary statistics only
SRK (1989)	Yes / Yes	—	Yes	—	—	—	—	—	—
TetraTech (1990a, b)	Yes / NA	Yes / —	Yes	—	Yes	—	Yes	Mussels, sole, sculpin	Visual inspection
Dames and Moore (1995)	Pb and Zn only	—	Yes	—	Yes	—	—	Mussels	Collected, but not analyzed
PND (1999)	Yes / —	Yes /—	Yes / —	—	—	—	—	—	—
PND (2005)	Yes / Yes	Yes	Yes	—	—	—	—	—	—
URS (2006)	Cu, Pb and Zn only	—	—	—	—	—	—	—	—
Gubala (2007)	Yes/Yes	—	—	—	—	—	—	—	—
TetraTech (2008)	Yes / Yes	—	Yes	Yes	Yes	Yes	Yes	Mussels	—
TetraTech (2009)	—	Yes / Yes	—	—	—	—	—	—	—
Gubala (2011)	Yes / Yes	Yes / Yes	—	—	—	—	—	—	—
Gubala (2013)	Yes / Yes (no Cu, Zn)	Yes / Yes	—	—	—	—	—	—	—
Anchor QEA (2015)	Yes / Yes	Yes / Yes	Yes / Yes	—	—	—	—	—	—

Notes: PW = pore water; SW = surface water; SEM:AVS = simultaneously extracted metals and acid volatile sulphides

1.3.2 Other Historical Information

Other types of data present in these historical documents that are not summarized in the table above include:

- Anchor (2015) conducted testing to investigate different dredge disposal options.
  - A sequential batch leaching test (SBLT) was conducted on four samples. This test is typically used to evaluate the potential for contaminants to leach from dredged material placed into an open-water disposal site (i.e., as the dredged material falls through the water column. The test involved mixing sediment with artificial seawater at a ratio of 1:4, agitating the sample on a shaker table for 24 hours, and then centrifuging the mixture to remove sediment. The process was then repeated three additional times with the original aliquot of sediment to generate four sequentially extracted water samples. Water samples were submitted for chemical analysis (e.g., dissolved metals). Data were compared to the Alaskan ambient water quality guidelines (Alaska Department of Environmental Conservation [ADEC] 2008). Dissolved concentrations of lead exceeded the Criterion Maximum Concentration (CMC) in two of the four samples. Dissolved concentrations of copper exceeded the CMC in all four samples. Anchor (2015) concluded that this information meant that the material would be unlikely to be suitable for open water disposal.

  - A toxicity characteristic leachate procedure (TCLP) test was conducted on four composite sediment samples to determine if the material was suitable for unconfined upland disposal. The leachable concentrations were compared to federal hazardous waste screening limits. Lead concentrations exceeded the screening limit and therefore, Anchor concluded that it would likely be necessary to dispose of the material in a permitted landfill capable of accepting hazardous waste (i.e., a Class C landfill).
  - Anchor noted that dredged sediment may be appropriate for beneficial reuse in a marine or upland setting if amendments were utilized.
- There has been limited sampling for simultaneously extractable metals and acid-volatile sulphides (SEM:AVS) in the historical data set. SEM:AVS provides a surrogate measurement for the bioavailability of divalent metals such as copper, lead and zinc. Tetra Tech (2008) found that seven of the ten samples with measurable AVS were unlikely to have high bioavailability. This finding reinforces the idea that relying on bulk sediment chemistry as the primary method of evaluating risks may overstate contaminant hazard.
- Tetra Tech (2008) conducted a toxicity identification evaluation (TIE) in conjunction with toxicity tests on whole-sediments collected from the Ore Basin. Porewater was extracted from two sediment samples that demonstrated 100% mortality to mysid shrimp in the whole-sediment toxicity tests. Porewater was also extracted from a reference sediment sample. The porewater samples were treated with an agent that would bind with divalent metals like copper, lead and zinc to reduce their toxicity. The treated samples were re-tested with the same mysid shrimp toxicity test, and no improvement in survival was observed, which suggests that metals were not the causative agent in the initial tests.

1.3.3 Sediment Transport Assessment

The degree to which sediment at the site would likely be erosional or depositional was identified as an initial data gap during the review of the documents summarized above. Sediment stability has the potential to influence the broader management plan for contaminated sediment because a site that is highly erosional suggests that: a) deeper sediment must be included in the ecological risk assessment because it will be exposed over time; and b) natural attenuation is unlikely to be a successful mitigation strategy because contaminated material may be re-suspended and redistributed. Golder completed a review of the existing reports and used readily-available information to conduct a preliminary sediment transport assessment of the Skagway Ore Basin (Golder 2016). This sediment transport assessment considered six mechanisms for sediment transport:

- extreme wind-generated waves and storm surges
- typical wind-generated waves
- typical wind-driven currents
- tidal currents
- river flows
- vessel propeller scour (tugs and large vessels)

The analysis described the characterization of sediments at and beneath the seabed in the Skagway Ore Terminal harbor basin as generally consistent with relict deposits from a coarse clastic braided river and delta distributary and tidal sand flat environment, including evidence of interbedded gravel and sand with some layers of silts (fines) deposited prior to harbor development. The sediment lithology is characteristic of the previously high energy environment where the harbor is now located. However, the current configuration cuts off the harbor from the riverine processes and the resulting environment is typically a low energy and depositional environment. The bathymetry change analysis, sediment sampling, and sediment coring between 1990 and 2015 are consistent with the pattern and timeline of dredging at the Broadway Dock and progressive accumulation of fine sediment near the Ore Dock. The advection or forcing of the Skagway River plume during the freshet is a mechanism that could explain accumulation of fine sediment near the Ore Dock. Mechanisms that could result in localized seabed scour in the ore terminal basin include vessel propeller wash (primarily during summer season) and wave orbital velocities during infrequent extreme storms in the winter season.

1.4 Remaining Data Gaps

Investigations to date have focused primarily on sediment chemistry, and have not been interpreted within a risk assessment framework in conjunction with other, equally important lines of evidence. A detailed human health and ecological risk assessment does not appear to have been completed. In terms of ecological and human health risks, Golder reviewed the available site information and concluded that:

- Metals (specifically, copper, lead and zinc) are the primary contaminants of concern related to the operation of the ore dock. There was sufficient information about the vertical and horizontal distribution of these metals in sediment based on the totality of samples collected (see Appendix A for the distribution of these three metals). Many historical samples were limited to these primary contaminants of concern and did not quantify other constituents. Notwithstanding this limitation, both lead and zinc were found to exceed the numerical screening limits for the protection of aquatic life at several locations and therefore, further assessment is appropriate.
- There was a moderate number of measurements of concentrations of other contaminants of potential concern (such as polycyclic aromatic hydrocarbons), although the data are inadequate to provide necessary spatial coverage. Multiple historical studies excluded analysis of samples for hydrocarbon concentrations. The available data show that there are exceedances of numerical screening limits for Polycyclic aromatic hydrocarbons (PAHs) in several locations (see Appendix A for the distribution of light and heavy molecular weight PAHs). The source of these hydrocarbons has not been conclusively established.
- The available sediment toxicity data are not sufficient to support an ecological risk assessment. There were no long-term chronic toxicity data available. Historical toxicity data were limited to one study (Tetra Tech 2008) that included:
  - Toxicity testing on six whole-sediment samples (plus one reference sample) were conducted using a 10-d amphipod survival and growth test, as well as a 10-d polychaete survival and growth test. There were no effects observed on amphipod survival and growth, or polychaete survival relative to the reference station. There were reductions in polychaete growth observed in three of the six samples collected from the study area relative to the reference station.
  - Toxicity testing on eight surface water samples (plus one reference sample) with a 96-h mysid shrimp survival test, and a 48-h larval fish survival test. No effects were observed.

- Information on the diversity, abundance and biomass of resident benthic organisms is not sufficient to support an ecological risk assessment. Tetra Tech (1990a) reported that the benthic community near the ore terminal was “obviously stressed” because there were few organisms present in the two stations that had the highest lead and zinc sediment concentrations. However, Tetra Tech (1990a) identified at least three other stations without organisms that were not considered to have highly elevated concentrations of metals. The observation by Tetra Tech (1990a) appears to be based on visual inspection of a limited number of samples (not quantitative analysis by a qualified taxonomist).
- The available data regarding concentration of metals in fish and other aquatic organisms is limited and has not been evaluated in the context of an ecological or human health risk assessment.
  - Several authors commented there was a general spatial pattern with tissue concentrations of lead and zinc higher in mussels collected from the vicinity of the ore dock relative to those collected elsewhere. Mussels were the most frequently sampled organism. The data were not sufficient to evaluate spatial patterns in tissue concentrations relative to sediment concentrations. Fish tissue samples were limited in number and did not consistently exhibit elevated concentrations of metals.
  - Tetra Tech (1990b) conducted a human health risk assessment on a limited seafood sampling data set (i.e., seven mussel samples; four yellowfin sole muscle samples) and concluded that risks associated with seafood consumption were acceptable for mercury and zinc. The evaluation for lead focused on the estimated contribution of seafood consumption to predicted lead concentration in human blood samples, and concluded that seafood consumption would not be a major exposure pathway. Golder understands that a blood lead sampling program was subsequently conducted for Skagway residents and concluded that risks associated with the cumulative lead concentration were acceptable. Golder understands that no further update or re-evaluation of risks associated with the potential consumption of seafood has been completed since 1990, and that at this point, the degree to which the site is used for subsistence or recreational harvesting is unclear.

2.0 STUDY DESIGN

2.1 General Approach

The sampling and analysis program supports a detailed quantitative ecological and human health risk assessment that is intended to determine whether there are unacceptable risks associated with sediment in the Ore Basin. If risks are found to be unacceptable, the risk assessment will focus on identifying specific areas where risk management or remedial actions may be necessary, and to the extent possible, will focus on determining the relative contribution of contaminants associated with ore concentrates (e.g., copper, lead and zinc) versus those contaminants which would be more likely associated with broader harbour operations (e.g., hydrocarbons).

The general study design involves:

- Consideration of the likely gradient of contamination based on the historical sediment chemistry data as a basis for collecting synoptic samples for chemistry, toxicity and benthic community. Gradient-based studies are recommended by Washington State Department of Ecology (WDOE) 2015. Additional samples will be collected from reference and background areas for context. Golder intends to collect more samples than will be required for biological analysis, and identify a subset of samples for further detailed analysis based on the concentration of metals. This approach provides confidence that samples selected for the biological analysis will be representative of the actual gradient of contamination at the site.

- Collection of crab and mussel tissue samples. These data will be used to determine whether there are unacceptable human health risks associated with the consumption of organisms from the vicinity of the Ore Dock. The differences in tissue concentrations between the Ore Dock and other areas in the region (e.g., elsewhere in Skagway Harbour; reference areas) also provides information about contaminant bioavailability and bioaccumulation that will be incorporated into the risk assessment.
- A selected subset of sediment samples will be submitted for the remaining chemistry analysis (i.e., PAHs) and laboratory toxicity testing. Toxicity data will be interpreted based on the marine biological criteria (for toxicity tests) established for the sediment cleanup objective (SCO) and cleanup screening levels (CSL)[1] as described by WDOE (2015). These biological criteria provide a basis for determining if an exceedance of the conservative, chemistry-based criteria constitutes an exceedance of the sediment management standards established by the State of Washington. The relationship between sediment chemistry and biological effects data will also be evaluated.
- If exceedances of the WDOE (2015) biological criteria are observed in the toxicity tests, Golder will consider additional lines of evidence:
  - A toxicity identification evaluation (TIE) will be conducted if exceedances of the biological SCOs or CSLs are observed in the toxicity test data. Pore water will be extracted from archived sediment samples and manipulated to selectively remove specific contaminants of interest in different treatments. Changes in toxicity in the manipulated versus unaltered porewater samples, when considered in aggregate, provides information about which specific substances are likely contributing to the observed toxicity.
  - Benthic community samples will be collected from all stations (and archived) as part of the original sampling. A subset of samples may be submitted depending on the results of the toxicity testing and the TIE. For example, benthic community data would be unlikely to change the overall risk conclusion if: a) the majority of sediment samples demonstrated negligible toxicity to all species tested, or b) the majority of sediment samples demonstrated significant and acute toxicity to multiple species that was related to the presence of metals.

2.2 Sample Locations

2.2.1 Selection of Ore Basin Locations

The historical sediment chemistry data were used as the basis for establishing the gradient of contamination in the Ore Basin. The analysis focused on the distribution and magnitude of individual substances of interest, as well as the sum of possible hazard from the mixture of multiple substances of interest using the following:

- Appendix A provides figures that illustrate the magnitude of concentration relative to the WDOE (2015) SCO and CSL[2] for individual contaminants of concern (copper, lead, zinc, light molecular weight PAH [LPAH], high molecular weight PAH [HPAH]).

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[1] The SCO represents the long-term sediment quality goal, while the CSL is the maximum chemical concentration or biological effects level allowed as a sediment cleanup level. They are used in conjunction for sediment risk management and remedial planning. The final sediment clean up level (i.e., the basis of design of remediation) is initially set at the more conservative SCO but can be adjusted upwards towards the CSL based on technical feasibility and net adverse environmental impacts as part of the selection of the remedial option.

[2] The Apparent Effect Threshold (AET)-based numerical criteria were used per WDOE (2015) guidance to use AET-based criteria when samples have a total organic carbon (TOC) content of less than 0.5%. The average TOC in samples collected from the Ore Basin was 0.2%.

- Figure 4 shows the cumulative frequency distribution of the sum of hazard quotients. Hazard quotients were calculated based on the WDOE (2015) sediment cleanup objective. The total hazard quotient for metals is broken down into a stacked bar chart to illustrate the relative contribution of different metals. The hazard quotient for total PAHs (i.e., the sum of the LPAH and HPAH hazard quotients [HQ]) is also provided where hydrocarbon data were available.
  - Figure 4a provides separate cumulative frequency distributions for surface samples (0 – 6 inches; the biologically active zone)
  - Figure 4b provides the cumulative frequency distribution for subsurface samples (6 – 36 inches)
- Figure 5 shows the spatial distribution of the sum of hazard quotients for metals in surface samples. The hazard quotient distribution was estimated through interpolation (linear relationship with distance) to highlight the likely extent of the areas of greatest interest.

Observations based on Figure 4 and 5 that were considered in the selection of specific locations for sampling include:

- The majority of the hazard from metals in the surficial sediment is associated with lead and zinc, although there are some samples that also have concentrations of arsenic or mercury that exceed the SCO (i.e., hazard quotients are greater than 1). Copper, chromium and silver do not appear to have wide-spread exceedances of the SCO and are not contributing significantly to the total hazard quotient. This observation suggests that the primary gradient of metals contamination should focus on lead and zinc as the major contributors.
- There was no obvious association between the total metals HQ and the total PAH HQ distributions based on visual inspection of Figure 4. Note that a statistical analysis was not completed, and therefore, the following points are intended only to highlight areas for further consideration as new data becomes available.
  - There may be other sources of petroleum hydrocarbons that have a different spatial distribution.
  - The total PAH HQ was above 10 in several samples which suggests that it may have the potential to cause adverse effects to benthic organisms. All samples submitted for toxicity testing will be analyzed for both PAHs and metals.
  - Deeper sediment layers also tended to have lead and zinc contributing the majority of the hazard, but arsenic was also present.
  - There were fewer subsurface samples relative to the surface, but the majority of the samples at depth included PAH analysis.
  - The hazard in the deeper sediment was lower than in surface (i.e., maximum total metals HQ in deeper sediment was less than 30, but was greater than 50 in the surface samples). This observation suggests that a defensible gradient that includes worst-case concentrations can be established based on surface sampling only.

2.2.2 Selection of Reference Locations

Reference samples are intended to be representative of Ore Basin samples in terms of physical attributes (e.g., grain size, organic carbon content, depth) but without the presence of contamination. Several reference areas have been previously sampled. Golder plans to sample the following three reference areas:

- Dyea Point—This area was previously sampled by Tetra Tech (2008), analyzed for metals, and included in the toxicity testing program. There were no exceedances of the SCO for metals[3] in the Tetra Tech (2008) TT-REF1 samples; however, this location appears to have different grain size distributions relative to the majority of samples collected by Tetra Tech (2008) from the Ore Basin. The location is not proximate to a river input (i.e., sediment is potentially less dynamic than the Ore Basin).
- Near the mouth of the Taiya River—This area was selected because it would be expected to have a dynamic sediment transport regime similar to that associated with the mouth of the Skagway River. This location was previously sampled (Tetra Tech 2009; also labelled as TT-REF1) for chemistry and no detectable concentrations of PAHs were found. Samples for metals chemistry have not been collected from this area, but there were no industrial or urban activities in this area that would likely be a point-source for metals.
- Head of Nakhu Bay—This area was sampled by Tetra Tech (2009; TT-REF2) for PAHs and by Tetra Tech (1990; TT-1 and TT-2) for metals. No detectable PAHs were observed, and metals concentrations are lower than the SCO.

Golder intends to collect samples from each of these three areas from a water depth consistent with the Ore Basin (30 – 40 feet). A final determination regarding which area will be used as the reference will be based on a review of the sample-specific chemistry and grain size/total organic carbon data.

2.2.3 Location and Number of Samples

Golder has identified proposed locations in the Ore Basin for sampling based on the historical chemistry data (Figure 6). As discussed above, a subset of those locations for the detailed chemistry, toxicology, and benthic community assessment will be assigned once sample-specific metal concentrations, grain size, and organic carbon content data are available. Table 2 describes the proposed sample collection effort with the expected number of samples to be submitted for toxicity testing.

[3] Sample was analyzed for Cd, Cu, Hg, Pb, Ni and Zn

Table 2: Proposed Sampling Effort

Name	Location	Stations for Initial Collection	Number of Samples to be Submitted for Toxicity Testing
Zone A—($\sum HQ_M > 10$)	Ore Basin	4	3
Zone B—($\sum HQ_M > 5$)	Ore Basin	5	3
Zone C—($\sum HQ_M > 1$)	Ore Basin	5	3
Zone D—($\sum HQ_M < 1$)	Ore Basin	5	2
Zone E—Far Field	Outside Ore Basin but within Skagway Harbour	3	1
Zone F—Reference	Dyea Point	3	3
	Taiya River	3	
	Nahku Bay	3	
TOTAL		31	Up to 15

Note: HQ_M - sum of the hazard quotients for metals based on WDOE (2015) CSL numerical criteria.

This approach:

- increases the likelihood that samples submitted for biological testing represent the underlying gradient
- provides an opportunity to consider confounding effects if grain size and organic carbon content are substantially different than measured in the historical data
- provides the opportunity to reduce or increase the number of stations for toxicity testing depending on the variability in the actual gradient of contamination found

3.0 SAMPLING AND ANALYTICAL METHODS

3.1 General Field Procedures

All field activities will be conducted in accordance with industry-standard methods as described by ADEC (2016), ASTM (2014), WDOE (2015), and other standard reference materials. ADEC (2016) will be followed in the event of a conflict in guidance. Industry-standard procedures include:

- All sampling will be conducted by trained, experienced personnel (i.e., a Qualified Environmental Professional) following a specific work instruction approved by the Golder project manager. Sampling will be conducted by Paddy McManus with assistance by Joe Marquardson. Blair McDonald will oversee the technical aspects of the project. Tamra Reynolds is the Golder Project Manager. The resumés for Paddy McManus, Emily Henkemans (proposed alternate to Joe Marquardson) and Blair McDonald are provided in Appendix B for approval by ADEC as Qualified Environmental Professionals. Tamra Reynolds has previously been approved by ADEC as a Qualified Environmental Professional; however, her resumé is also provided if required. The resumé of Joe Marquardson is provided in Appendix B for approval by ADEC as a Qualified Sampler. This sampling and analysis plan, as well as copies of appropriate technical guidance (ADEC 2016; American Society for Testing and Materials (ASTM) 2014; WDOE 2015) will be available on-site during sampling activities.

- A field log will be maintained (with standard forms where appropriate) to record field observations, time of sampling activities, site sketches, records of observations and discussions, safety briefings, etc. All equipment will be calibrated following manufacturer's specifications and the calibration results recorded.
- All samples will be placed in laboratory-supplied containers, preserved as directed by the analytical laboratories, and maintained at the appropriate temperature (see Appendix D of ADEC 2016). A typical post-collection holding temperature is 4ºC which will be achieved using ice fragments placed in double-sealed Ziploc bags. Samples will be packed in coolers for transport to the analytical laboratory to prevent breakage and to keep the weight of each cooler at a safe limit. All samples will be recorded on laboratory-provided chain of custody forms and each cooler will be sealed with a custody seal. The logistics of sample transport will be reviewed to confirm that holding times and holding temperatures mandated by the analytical methods will be met.
- Any deviation from the sampling and analysis program as a result of site-specific conditions will be identified and approved by the Golder project manager in advance. A record of the decision will be maintained, and significant deviations (e.g., unable to collect any samples from a desired zone) will be promptly discussed with ADEC. A copy of the field log and all related forms and photographs will be provided as an appendix in the risk assessment report.

3.2 Sediment Sample Collection

Sediment samples for chemistry and toxicity analysis will be collected following ADEC (2016). In brief:

- The sampling vessel will position itself on the desired coordinates based on GPS readings. The vessel has a Garmin 19X GPS antenna as part of its navigational software with an accuracy of ±10 ft. Other navigational aids include radar and depth sounders. The vessel will also use the same GPS to record the positions of fixed landmarks that are visible on aerial photos (e.g., wharf structures and dolphins) to provide visual confirmation of the final sample locations.
- Bulk sediment samples will be collected using a van Veen grab sampler. The van Veen has a surface area of 1.0 ft^2 and can achieve a depth of up to 1 ft, resulting in a total sediment volumes of up to 8 gallons per grab (ASTM 2014). The van Veen will be outfitted with additional weights to help it penetrate harder substrates.
- Only those grab samples that meet the following acceptability criteria will be retained:
  - The sampler is fully closed and does not contain large rocks or other debris.
  - There is adequate penetration depth (i.e., at least 0.5 ft to retrieve an undisturbed 0.3 ft upper horizon).
  - The sample is not overfilled or disturbed, and sampler was not deployed on an angle (i.e., sediment surface does not touch the top of the sampler, and is relatively flat).
  - The sampler is not leaking (i.e., there is overlying water present and no visible leaks).
- Upon acceptance, the overlying water in the grab will be removed using a siphon taking care to minimize the loss of fine sediment from the surface of the grab contents. A description of the sediment (colour, particle size, odour, and presence of non-sediment materials such as shells, debris, biota) will be recorded.

- The sediment from the top 0.3 ft of the sample will be removed with a clean metal spoon from the center of the grab (without touching the sides) and placed in a stainless steel bowl. Sediment deeper than 0.3 ft will be discarded. The decision to focus on the top 0.3 ft is based on guidance from WDOE (2015; Section 3.4.1).
- Once sufficient sediment volume has been collected to fill the laboratory supplied containers (see Table 3) the sediment will be homogenized until the color and texture are consistent. Aliquots will then be transferred to the sampling containers. The sediment samples will be stored in a cooler with ice packs and maintained under chain of custody procedures.
- Record observations in the surface sediment collection log regarding the appearance of the sediment (i.e., texture, colour, odour, presence of biota, sheen, or detritus, depth of sediment horizon sampled, grab penetration depth, coordinates). A photograph of the composite sediment sample with the station name clearly legible in the photograph will be taken.
- All sampling equipment will be cleaned between samples by scrubbing them free of visible sediment, washing with laboratory-grade detergent, rinsing with site-water, and then rinsing with distilled or de-ionized (analyte-free) water. Rinse water and any excess collected sediment will be released to the environment (at least 100 feet from a proposed sample location) provided that visible contamination is not observed. If visible contamination (e.g., sheen, petroleum odors) are noted, waste will be containerized for off-site disposal in accordance with the applicable regulations.

Table 3: Sampling requirements, volume, container and preservative, and holding times.

Analysis	Sample Volume	Holding Time
Chemistry		
DRO/RRO + PAH	4 oz (120 mL) glass jar	14 days
PAH		14 days
Mercury	4 oz (120 mL) glass jar	28 days
Metals		6 months
AVS-SEM	4 oz (120 mL) glass jar	2 weeks for AVS, 6 months for metals
Total organic carbon	4 oz (120 mL) glass jar	28 days
Grain Size Analysis	2 x 8 oz (120 mL) glass jar	6 months
Archive	4 oz (120 mL) glass jar	Not applicable
Toxicity		
Standard tests	1 gallon HDPE pail	2 weeks (up to 8 weeks if samples stored under nitrogen)
Archive for potential TIE	1 gallon HDPE pail	8 weeks

Note: DRO: Diesel range organics; HDPE: High density polyethylene; RRO: Residual range organics; PAH: Polycyclic aromatic hydrocarbons; TIE: Toxicity identification evaluation

3.3 Sediment Chemistry Analysis

Sediment chemistry analyses will be conducted by ALS Environmental in Kelso, Washington. ALS is an ADEC-accredited laboratory (certification number UST-040). Sediment samples will be shipped in coolers with ice packs (Alaska Sea Planes to Juneau, AK; Alaska Airlines to Seattle, WA). The laboratory analyses will include laboratory control samples (LCS), matrix replicates, matrix spikes (MS), surrogate spikes for organic analyses, method blanks, standard reference materials and initial and continuing instrument calibrations.

Table 4: Sediment Chemistry Analytical Methods

	Units	WDOE (2015)		Method Reportable Limit
		SCO	CSL	
Grain size analysis (ASTM D422)		—	—	
Total organic carbon (Walkey-Black)	%	—	—	0.2
Metals (EPA 6010C, 6020A, 7471B)				
Aluminum (Al)	mg/kg	—	—	4
Antimony (Sb)	mg/kg	—	—	0.05
Arsenic (As)	mg/kg	57	93	0.5
Barium (Ba)	mg/kg	—	—	0.05
Beryllium	mg/kg	—	—	0.02
Cadmium (Cd)	mg/kg	5.1	6.7	0.02
Cobalt (Co)	mg/kg	—	—	0.02
Copper (Cu)	mg/kg	390	390	0.1
Chromium (Cr)	mg/kg	260	270	0.2
Iron (Fe)	mg/kg	—	—	4
Lead (Pb)	mg/kg	450	530	0.05
Magnesium (Mg)	mg/kg	—	—	2
Manganese (Mn)	mg/kg	—	—	0.05
Mercury (Hg)	mg/kg	0.41	0.59	0.02
Nickel (Ni)	mg/kg	—	—	0.2
Selenium (Se)	mg/kg	—	—	1
Silver (Ag)	mg/kg	6.1	6.1	0.02
Thallium (Tl)	mg/kg	—	—	0.02
Vanadium (V)	mg/kg	—	—	0.2
Zinc (Zn)	mg/kg	410	960	2
Hydrocarbons (EPA 6270D)				
2-methylnapthalene	µg/kg	670	670	5
Acenaphthene	µg/kg	500	500	5
Acenaphthylene	µg/kg	1300	1300	5
Anthracene	µg/kg	960	960	5
Benzo(a)anthracene	µg/kg	1300	1600	5
Benzo(a)pyrene	µg/kg	1600	1600	5
Benzo(b)fluoranthene	µg/kg	—	—	5
Benzo(g,h,i)perylene	µg/kg	670	720	5
Benzo(k)fluoranthene	µg/kg	—	—	5
Chrysene	µg/kg	1400	2800	5
Dibenz(a,h)anthracene	µg/kg	230	230	5
Fluoranthene	µg/kg	1700	2500	5
Fluorene	µg/kg	540	540	5
Indeno(1,2,3-cd)pyrene	µg/kg	600	690	5
Naphthalene	µg/kg	2100	2100	5
Phenanthrene	µg/kg	1500	1500	5
Pyrene	µg/kg	2600	3300	5
Diesel Range Organics (AK102)	mg/kg	—	—	20
Residual Range Organics (AK101)	mg/kg	—	—	20

Notes: SCO: Sediment Cleanup Objectives; CSL: Cleanup Screening Levels "—" = no standard

3.4 Benthic Community Sample Collection and Analysis

Collection and handling of benthic community samples will be conducted according to Puget Sound Estuary Program (PSEP), 1987 as recommended by WDOE 2015. In brief:

- Benthic samples will be collected using the same van Veen grab sampler and acceptability criteria described above. A benthic sample consists of the entire acceptable sediment volume of the grab sampler (i.e., 0.1 m^2 × 0.1 m depth = 10 L). Three replicate samples, each consisting of one complete grab, will be collected at each station.
- Benthic infaunal samples will be washed on the boat (or a suitable shore-based location) during field operations. Each successful Van Veen grab sample will be placed in a large plastic container, allowing the sample to be screened in portions, and minimizing the time that fragile organisms are in contact with the screen. The sieved samples will be photographed and described in the field log.
- Field washing will be carried out using a portable stainless steel tray with a 0.04-inch mesh bottoms. The washing system includes a water pump for washing fine sediment from the sample. The wash water intake hose has a filter to prevent planktonic organisms or other debris from entering the sample. Rinse water will be disposed as described above.
- Preservation will be achieved by adding a defined volume (e.g., 100 mL in 1 L) of full-strength buffered formalin (prepared as described in PSEP, 1987) to each sample jar. Calcium carbonate chips will be added to samples in the field to maintain neutral pH in preserved samples. After adding the fixative, the sample container contents are mixed by gentle rolling.
- Samples will be transported to Marine Taxonomic Services Ltd. (San Marcos, CA), where technicians will promptly transfer the contents of the benthic sample to alcohol to prevent sample degradation.
- Ten percent of the samples will be re-sorted to confirm 95% sorting efficiency has been achieved. A sample “passes” if the number of organisms found during the QA/QC check is <5% of the total number of organisms found in the entire sample.

3.5 Tissue Sample Collection and Analysis

Sampling will focus on mussels and crabs as representative examples of aquatic organisms that have the potential to be consumed by recreational or sustenance fishers. Mussels are sessile, and many crab species have relatively small home ranges relative to fish and therefore, their tissue concentrations provide a more reliable evaluation of bioaccumulation from bedded and suspended particulates. Golder is not proposing to collect fish at this time. Sampling will focus on three areas (Figure 6):

- Ore Basin (near-field)
- Outer Ore Basin near the Broadway Dock and entrance to the small craft harbour (far-field)
- Reference (not shown on Figure 6)

Each area will consist of five samples for spatial coverage. Each sample will consist of a minimum of five organisms in order to obtain sufficient mass for the composite sample. Mussels will be collected from intertidal substrates (i.e., the shoreline, wharf infrastructure) at low tide. Crabs that are of the legal size for capture and consumption will be collected using recreational crab traps Records on the size and number of organisms will be made. Organisms will be frozen, placed in laboratory-supplied containers and transported to the analytical laboratory for the removal and analysis of edible tissues. Dissection will not occur in the field because of the potential for cross-contamination from airborne soil or ore concentrate particles (dusts).

Table 5: Tissue chemistry analytical methods

	Units	Method Reportable Limit
Metals (EPA 6010C, 6020A, 7471B)		
Aluminum (Al)	mg/kg	2
Antimony (Sb)	mg/kg	0.05
Arsenic (As)	mg/kg	0.5
Inorganic Arsenic (As)	mg/kg	0.02
Barium (Ba)	mg/kg	0.05
Beryllium	mg/kg	0.02
Cadmium (Cd)	mg/kg	0.02
Cobalt (Co)	mg/kg	0.02
Copper (Cu)	mg/kg	0.1
Chromium (Cr)	mg/kg	0.2
Iron (Fe)	mg/kg	1
Lead (Pb)	mg/kg	0.02
Magnesium (Mg)	mg/kg	0.1
Manganese (Mn)	mg/kg	0.05
Mercury (Hg)	mg/kg	1
Nickel (Ni)	mg/kg	0.2
Selenium (Se)	mg/kg	0.1
Silver (Ag)	mg/kg	0.02
Thallium (Tl)	mg/kg	0.02
Vanadium (V)	mg/kg	0.2
Zinc (Zn)	mg/kg	0.5
Hydrocarbons (EPA 6270D)		
2-methylnapthalene	µg/kg	5
Acenaphthene	µg/kg	5
Acenaphthylene	µg/kg	5
Anthracene	µg/kg	5
Benzo(a)anthracene	µg/kg	5
Benzo(a)pyrene	µg/kg	5
Benzo(b)fluoranthene	µg/kg	5
Benzo(g,h,i)perylene	µg/kg	5
Benzo(k)fluoranthene	µg/kg	5
Chrysene	µg/kg	5
Dibenz(a,h)anthracene	µg/kg	5

	Units	Method Reportable Limit
Fluoranthene	µg/kg	5
Fluorene	µg/kg	5
Indeno(1,2,3-cd)pyrene	µg/kg	5
Naphthalene	µg/kg	5
Phenanthrene	µg/kg	5
Pyrene	µg/kg	5

3.6 Sediment Toxicity Testing

Sediment toxicity testing will be completed by Nautilus Environmental (Burnaby, BC). Nautilus is accredited by the Washington State Department of Ecology. In brief:

- Each sediment sample will be tested with three toxicity tests specified by WDOE (2015):
  - 10-d amphipod survival—The most likely species for this test are *Rhepoxynius abronius* or *Eohaustorius estuarius* based on the observation that sediment will tend to consist of sand. Interstitial salinity will be confirmed prior to the final test selection. *R. abronius* prefers a salinity of greater than 25 ppt, whereas *E. estuarius* can handle a broad salinity range (WDOE 2015).
  - 48-h larval development—The most likely species for this test are oysters (*Crassostrea gigas*), blue mussels (*Mytilus edulis* or *M. galloprovincialis*), or sea urchins (*Strongylocentrus purpuratus* or *S. droebachiensis*). Other test species such as sand dollars are also available, but are not preferred because these organisms tend to inhabit fine-grained sediments that are not likely present at the site. The final selection will be based on availability from organism suppliers. Mussels are likely to be available in late spring when testing is being contemplated; species selection will require consideration of the reproductive status of cultures and health quality of candidate organisms at the time of sampling.
  - 20-d polychaete survival and growth—This test is conducted with juveniles of *Neanthes arenaceodentata*.
- Test acceptability criteria and detailed methodologies have been developed for all three tests by PSEP (1995) and will be followed by the analytical laboratory. Test performance standards (WDOE 2015; Table 5-9) regarding negative controls (i.e., amphipod and polychaete survival ≥90%; polychaete growth >0.72 mg/ind/day; bivalve normal survival ≥90%). Other test acceptability requirements (e.g., maintenance of dissolved oxygen, pH and temperature limits specified by the test, successful reference toxicant tests) must also be achieved in order for the data to be considered acceptable.
- All three tests are routinely used for sediment characterization and dredged material disposal purposes by state regulatory agencies in the Pacific Northwest as well as British Columbia, and there is extensive toxicological literature available with respect to the sensitivity of these test organisms to the specific contaminants of interest, along with information on sensitivity to other factors such as grain size, ammonia, and sulphides.

3.7 Toxicity Identification Evaluation

The toxicity identification evaluation will be executed by environmental toxicologists with considerable expertise in the design and implementation of sediment TIEs. In brief:

- Pore water for the TIE will be extracted from the archive sediment sample following ADEC (2016). The archive sample will be gently homogenized to re-incorporate any overlying water. Aliquots will be distributed to the centrifuge containers and spun for 30 minutes. Pore water samples will be generated immediately prior to the TIE, and will not be filtered prior to use.
- The specific test treatments will be based on regulatory guidance (USEPA 2007) and the relevant peer-reviewed scientific literature. Naval Facilities Engineering Services Centre (NFESC) 2003 also provides practical guidance on the design and execution of sediment TIE for US naval facilities that may be relevant in the current investigation. A typical phase I TIE focuses on removing the influence of organic substances (such as PAHs) by passing the sample through a C18 extraction column. The influence of specific metals are removed through chelation with sodium thiosulphate (STS) or ethylenediaminetetraacetic acid (EDTA) in combination with filtration. The influence of ammonia can be evaluated through pH manipulation.
- The specific test organism will be dependent on the results of the whole-sediment toxicity testing. The typical approach is to use a limited number of organisms and to conduct testing with relatively small volumes of pore water. The most likely test organism would therefore be the 48-h larval development test. A 96-h mysid LC_{50} (used by previous investigations at the site) is also a potential candidate.

4.0 RISK ASSESSMENT WORK PLAN

ADEC (2015) emphasizes the importance of submitting work plans for the proposed risk assessment. In effect, the work plan for the risk assessment contains the majority of the components typically included in the problem formulation, as well as a detailed description of the specific methods to be used in the risk assessment analysis. Many of the topics listed in ADEC (2015, Section 2.2) are outlined in detail in the previous sections. Golder has reviewed the remaining items and can provide the following supplemental information to help frame the intended direction of our investigation. However, specific risk assessment methodologies (especially for the ecological risk assessment) will continue to evolve as sample data becomes available. Ongoing dialogue on these technical items is expected.

4.1 Human Health Work Plan

Supplemental comments to address ADEC (2015, Section 2.2) guidance that is not already addressed in previous sections is as follows:

- The site description, figures and data summaries from previous investigations were used to develop the concentration gradients as described in this work plan. Golder has also provided an in depth review of the historical information as part of our presentation to ADEC (and a brief overview is provided in Section 1.3). A detailed summary of the historical investigations will be included in the risk assessment report.
- Our sampling plan has considered the adequacy of the detection limits in both sediment and tissue samples.

- A detailed discussion of the expected contaminant fate and transport will be incorporated into the risk assessment. Golder has previously highlighted that generic numerical standards do not necessarily reflect the bioavailability of contaminants under site-specific conditions. Site-specific bioavailability appears to be a factor that requires consideration in the current assessment given that TetraTech (2008) found that porewater and whole-sediment toxicity were not necessarily caused by metals, despite the presence of metal concentrations that exceeded generic guidelines. In terms of contaminant fate, the bioavailable fraction of copper, lead and zinc that partitions from the ore concentrate to porewater will be the primary issue to be resolved in the risk assessment.

- A graphical conceptual site model has not yet been prepared. In brief, the human health risk assessment that has been described should be considered screening-level. Golder intends to collect tissue samples (crab, mussel) from targeted areas to determine if tissue concentrations are clearly problematic in terms of human health. At this point, a detailed country foods assessment to determine which species are harvested, at what frequencies has not been completed, nor is it likely to be necessary.

- Toxicity data for the human health risk assessment will be adopted from USEPA sources (i.e., IRIS). Risk screening levels will follow ADEC (2015) guidance for a screening-level RA (ILCR = 1x10-6, HQ = 0.1). Risks will be determined using the default values for human health receptors (e.g., food ingestion rates; portion size, etc.) as described by USEPA. Receptors will focus on recreational fishers. Subsistence and/or tribal fishers are not considered likely given that the site is part of an industrial harbour where fishing activities would likely be limited. These receptors can be added to the risk assessment if needed.

- Other potential exposure pathways related to the historical or current operation of the site (e.g., direct contact with water, dust inhalation; dust migration to upland areas) are not being assessed at this time. Golder concludes that a screening-level risk assessment that focuses on recreational fishing for crabs or mussels should be sufficient to make an informed management decision about whether or not immediate removal of sediment is required. The final decision about how to utilize the screening-level risk estimates for making an informed management decision will be explored in consultation with ADEC depending on the outcome of the risk calculations. Specifically, if HQs or ILCRs are substantially higher than the risk limits, and show a clear pattern where risks escalate with proximity to the source (i.e., the metals related to historical or ongoing site operation), it would be reasonable for risk management to focus on source removal. However, if risk exceedances are marginal, potentially unrelated to historical site activities, or limited to the Ore Dock basin where recreational fishing would not be allowed, it would suggest that further refinement might be needed before making a final risk management decision.

- Golder has previously commented on the adequacy of the historical tissue sampling to guide site management decisions. The initial list of contaminants of potential concern are metals and hydrocarbons. A key point is that the objective of the risk assessment is to determine if the historical operation of the Ore Dock has resulted in unacceptable risks, not to quantify the relative contribution of each and every contaminant that may be present in sediment from all point and non-point sources related to Skagway Harbour.

    - The specific metals that are related to historical operation of the Ore Dock are lead and zinc, and the specific metal related to the current operation is copper. Other metals will be included in the sediment and tissue analysis, but are not necessarily attributable to the industrial activity that would

- Hydrocarbons are being included in the risk assessment based on historical information that suggests that PAHs are both present and potentially contributing to adverse effects. There is no specific evidence that Golder is aware of that suggests that historical site activities created a point source of hydrocarbons. Hydrocarbons are potentially related to non-point sources such as harbour traffic and the use of creosote-preserved timbers.
- Tributyltin has been identified by others as a potential contaminant of concern, but would not be typically included in a sediment assessment unless there was historical information suggesting that the site (or nearby surroundings) were used for shipbuilding or repairs.

4.2 Ecological Risk Assessment Work Plan

Supplemental comments to address ADEC (2015, Section 2.2) guidance that is not already addressed in previous sections (or in the human health risk assessment work plan comments) is as follows:

- The focus on risk assessment is on the benthic and epibenthic community because these ecosystem components are in direct contact with sediment. The assessment endpoint is to protect these ecosystem components from unacceptable reductions in survival, growth or reproduction. The specific lines of evidence include toxicity testing, benthic community structure and bioaccumulation as described in previous sections. A graphical conceptual model has not been prepared, but as with the human health risk assessment, Golder is conducting a screening-level risk assessment that focuses primarily on the realistic worst-case exposure pathway (i.e., direct contact of organisms to sediment) that is attributed to the historical operation of the Ore Dock. The risk assessment is not intended to quantify the relative contribution of each and every contaminant that may be present in sediment from all point and non-point sources related to Skagway Harbour. As with the human health risk assessment, the contaminants of potential concern will focus on copper, lead and zinc, but other potential contaminants of concern (metals, hydrocarbons) are being considered because they are expected to be present and could potentially be exerting adverse effects as well.
- The ecological scoping evaluation, screening evaluation and data evaluation has been previously described in our presentation and is summarized in previous sections. As with the human health risk assessment, a detailed discussion of the available historical information will be included in the risk assessment report.
- Information from the sediment transport analysis (Golder 2016) will be included into the risk assessment process.
- The analysis approach and methods for determining risk-based concentrations will follow Washington State and USEPA guidance. There is a considerable body of scientific literature with respect to weight of evidence assessment that will be used to supplement and refine the guidance where appropriate.
- No modeling is contemplated at this time.

5.0 REPORTING

Interim deliverables will be provided during the course of this investigation as follows:

- A field work summary report (per ADEC 2016) will be prepared that provides a detailed description of the sampling program along with figures showing the locations of all samples. Site photographs, field records, laboratory certificates of analysis and laboratory review checklists will be included. A table of sediment chemistry results will be provided along with justification for selecting a representative subset of samples for the toxicity testing program. Golder anticipates that this summary report would be provided within two weeks of receiving the final certificates of analyses from the analytical laboratory.
- Updates will be provided with tabular summaries and laboratory certificates of analysis for subsequent stages of the investigation. Golder anticipates that these updates will be provided within two weeks of receiving the final analytical reports from the laboratory.
- A detailed risk assessment report will be prepared. The objective of the report is to provide decision-makers with a science-based analysis of the potential risks to human and ecological receptors as a result of sediment contamination in the Ore Basin. If risks are found to be unacceptable, a high-level review of possible remediation or risk mitigation activities will be provided.
  - Golder has reviewed ADEC (2015) guidance with respect to the required elements for a risk assessment report. No issues in terms of incorporating ADEC guidance with the general approach used for risk-based management of sediment described by WDOE have been identified.
  - Golder acknowledges the importance of providing a clear narrative as part of the risk characterization (ADEC 2015, Section 3.4) that considers both the magnitude and uncertainty of any risk calculations. The requirement for transparency, clarity, consistency and reasonableness is of particular importance in a sediment weight-of-evidence approach. Golder has incorporated the intent of the ERA process in Alaska (ADEC 2015, Section 4.1) in terms of designing a tiered approach that is meant to assist in making an informed management decision regarding whether or not remedial dredging is required as a result of the historical or ongoing operation of the Ore Dock. In this approach, it may not be necessary to proceed down successive tiers if a defensible risk management decision can be made based on an earlier tier or a qualitative evaluation.

The current schedule is that sampling is proposed to be conducted in April 2017, with a final risk assessment report ready by November 2017. The final timeline is dependent on how many tiers of the investigation are ultimately required.

6.0 CLOSURE

We trust the information contained in this document is sufficiently detailed for your review purposes. Should there be any questions please contact the undersigned at 604-297-2013.

Yours very truly,

GOLDER ASSOCIATES LTD.

Blair McDonald, MET, RPBio
Associate, Senior Environmental Scientist

Tamra Reynolds, MSc, PGeo
Project Manager, Senior Hydrogeologist

Gary Lawrence, MRM, RPBio
Associate, Senior Environmental Scientist

BGM/GSL/lih/lmk

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7.0 REFERENCES

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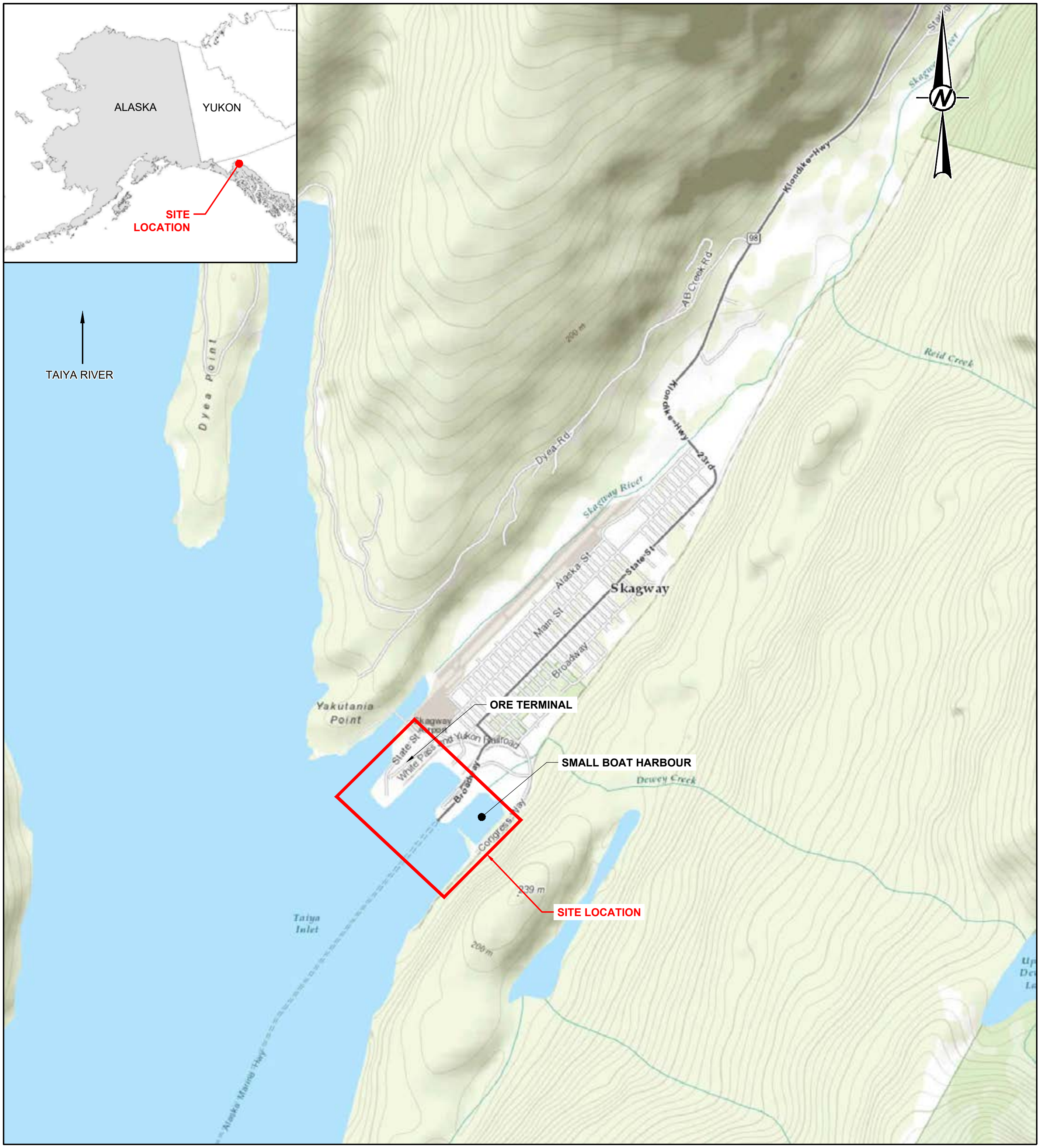
APPENDIX A

Chemistry Figures



REFERENCE

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CLIENT
WHITE PASS AND YUKON ROUTE

PROJECT
OREBASIN SEDIMENT ASSESSMENT
SKAGWAY, ALASKA

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-04-17
PREPARED	RTJ
DESIGN	LC
REVIEW	TR
APPROVED	GH

TITLE
KEY PLAN

PROJECT No.	PHASE	Rev.	FIGURE
1657231	1050	1	1

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- GUBALA AND ASSOCIATES SAMPLE LOCATION
- TETRA TECH SAMPLE LOCATION
- URS SAMPLE LOCATION (2006)
- DAMES AND MOORE SAMPLE LOCATION (1995)
- TETRA TECH SAMPLE LOCATION (1990)
- RWM SAMPLE LOCATIONS (1984)
- PERATROVICH, NOTTINGHAM & DRAGE SAMPLE LOCATIONS (1999)

NOTE

ALL SAMPLE LOCATIONS ARE APPROXIMATE

REFERENCES

BASE IMAGE PROVIDED BY THE ALASKA MAPPED PROGRAM (HTTP://WWW.ALASKAMAPPED.ORG) AND UAF-GINA (HTTP://WWW.GINA.ALASKA.EDU).
IMAGE GEOREFERENCED BY GOLDER AND INTENDED FOR INDICATIVE PURPOSES ONLY
DATUM: NAD 83, PROJECTION: UTM ZONE 8

BATHYMETRY DATA PROVIDED BY NOAA
H10972: NOS Hydrographic Survey , Skagway Harbor, Alaska, 2000-05-03

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CLIENT
WHITE PASS AND YUKON ROUTE

PROJECT
SEDIMENT ASSESSMENT PROGRAM
SKAGWAY ORE BASIN
SKAGWAY, AK

TITLE
SURFACE SEDIMENT AND CORE SAMPLE APPRO□IMATE LOCATIONS IN SKA□□AY ORE BASIN

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-04-17
PREPARED	RTJ
DESIGN	TR
REVIEW	TR
APPROVED	BM

PROJECT No.	PHASE	Rev.	FIGURE
1657231	1050	1	2

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- TETRA TECH REFERENCE SAMPLE LOCATION (1990)

NOTE

ALL SAMPLE LOCATIONS ARE APPROXIMATE

REFERENCE

BACKGROUND IMAGE SUPPLIED BY AND SOURCED UNDER LICENSE FROM BING IMAGES FOR ARCMAP ON : SEPT 19, 2016 IMAGE DATE: SEPT, 2010
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WHITE PASS AND YUKON ROUTE

PROJECT
SEDIMENT ASSESSMENT PROGRAM
SKAGWAY ORE BASIN
SKAGWAY, AK

TITLE
REFERENCE SEDIMENT SAMPLE LOCATIONS

CONSULTANT

YYYY-MM-DD	2017-04-17
PREPARED	RTJ
DESIGN	TR
REVIEW	TR
APPROVED	BM

PROJECT No.	PHASE	Rev.	FIGURE
1657231	1050	1	3

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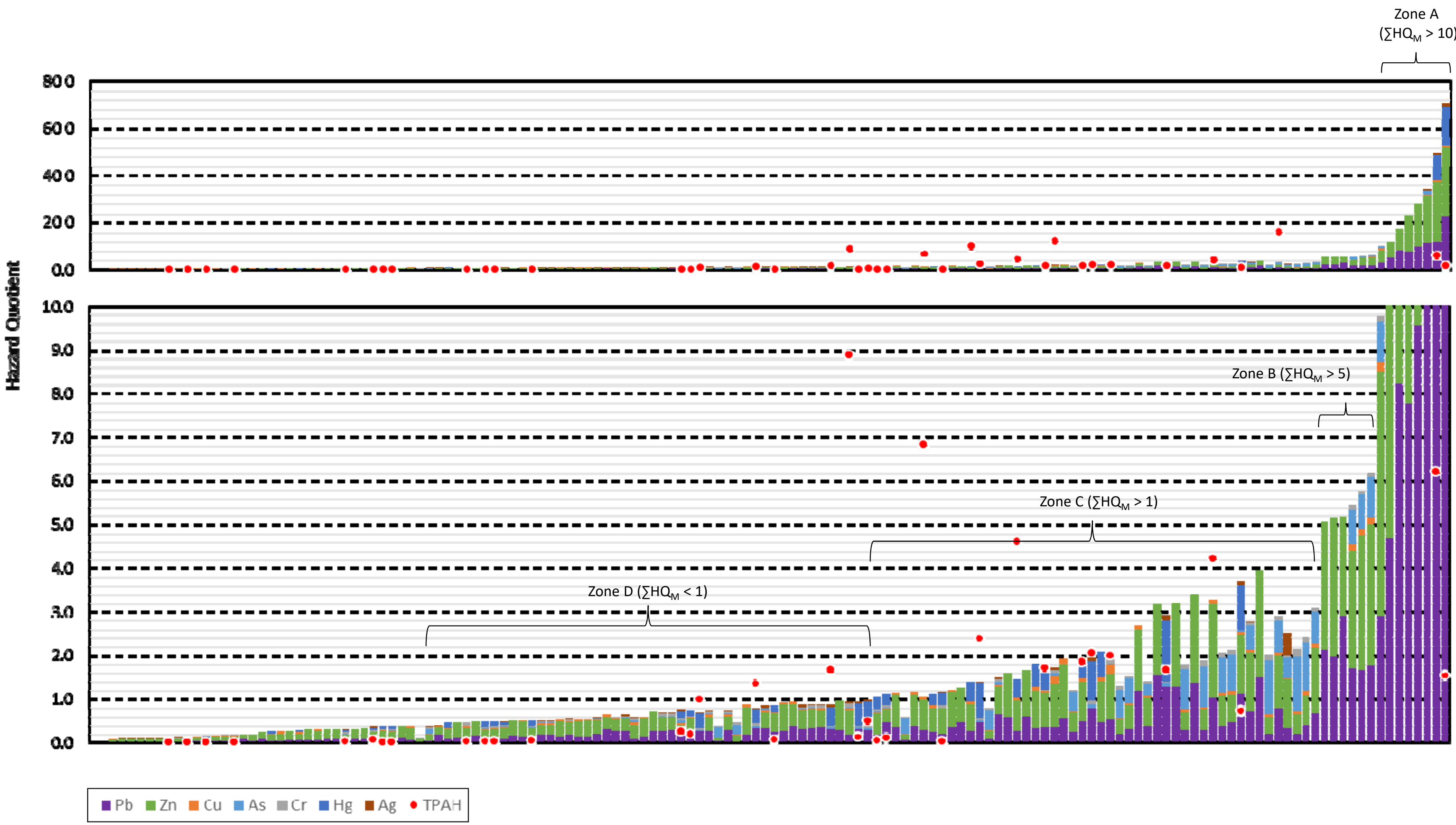

CLIENT
WHITE PASS AND YUKON ROUTE

CONSULTANT

YYYY-MM-DD	2017-04-17
PREPARED	BGM
DESIGN	BGM
REVIEW	TJR
APPROVED	GL

PROJECT
STUDY DESIGN AND SAMPLING AND ANALYSIS PLAN
ORE BASIN, SKAGWAY, ALASKA

TITLE
DISTRIBUTION OF HAZARD QUOTIENTS FOR SURFACE SAMPLES (0 – 6 INCH)

PROJECT No.	PHASE/TASK	Rev.	FIGURE
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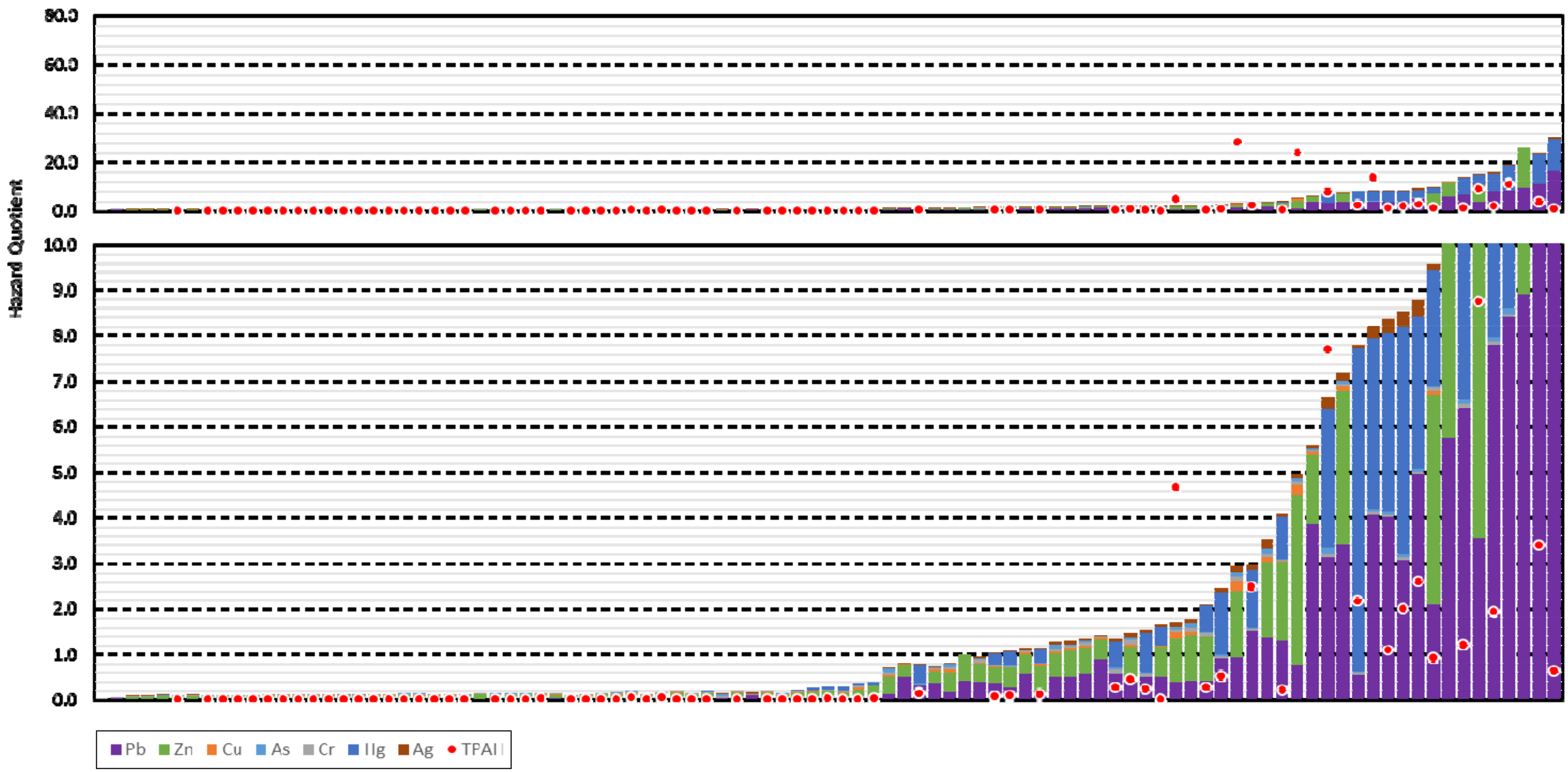

CLIENT
WHITE PASS AND YUKON ROUTE

PROJECT
STUDY DESIGN AND SAMPLING AND ANALYSIS PLAN
ORE BASIN, SKAGWAY, ALASKA

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-04-17
PREPARED	BGM
DESIGN	BGM
REVIEW	TJR
APPROVED	GL

TITLE
DISTRIBUTION OF HAZARD QUOTIENTS FOR
SUBSURFACE SAMPLES (6 – 36 INCH)

PROJECT No.	PHASE/TASK	Rev.	FIGURE
1657231	1000	1	4B


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TETRA TECH SAMPLE LOCATION
URS SAMPLE LOCATION (2006)
DAMES AND MOORE SAMPLE LOCATION (1995)
TETRA TECH SAMPLE LOCATION (1990)
RWM SAMPLE LOCATIONS (1984)
PERATROVICH, NOTTINGHAM & DRAGE SAMPLE LOCATIONS (1999)
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NOTE
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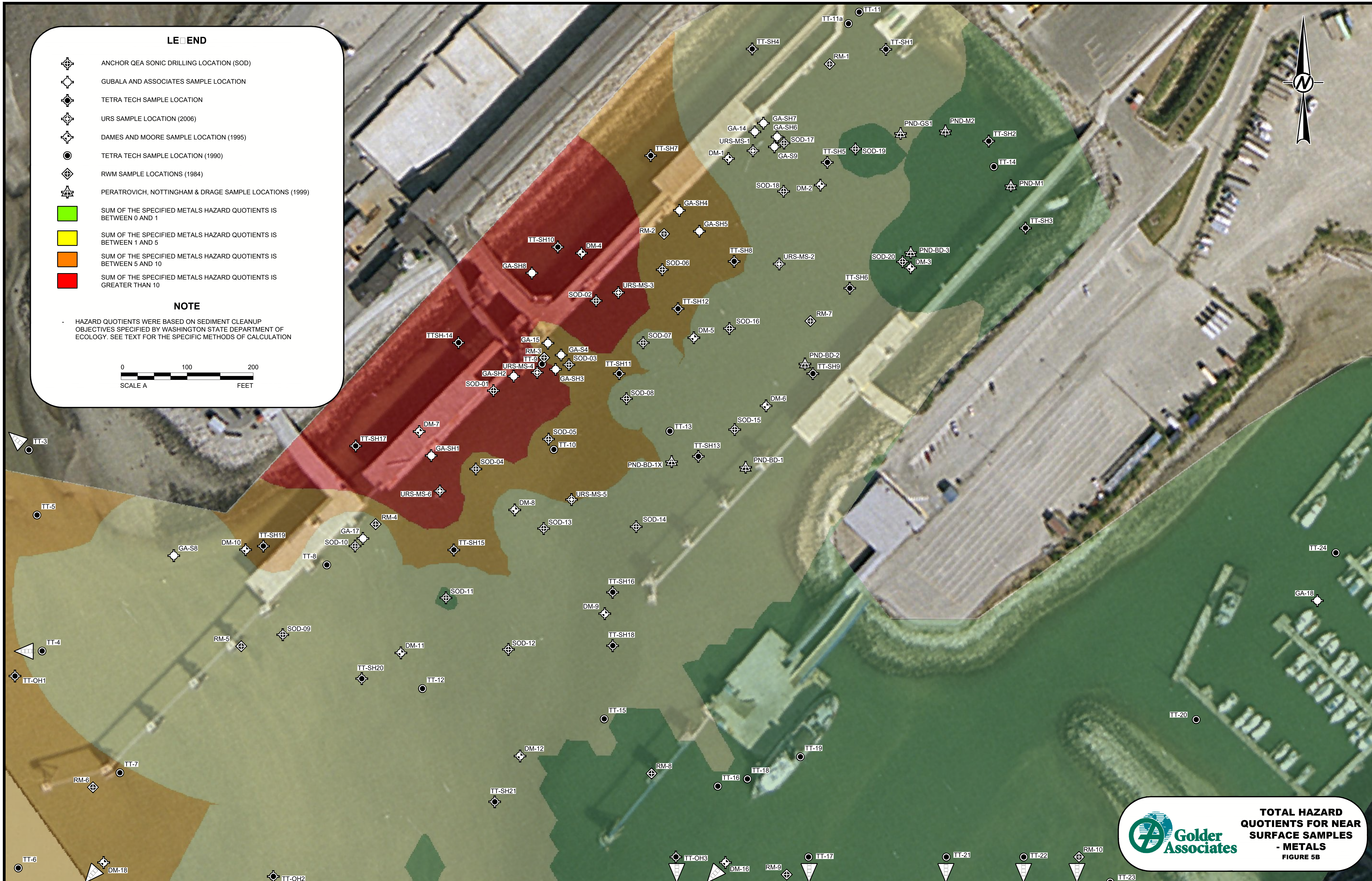
Golder Associates
TOTAL HAZARD QUOTIENTS FOR SURFACE SAMPLES - METALS
FIGURE 5A



LEGEND
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TETRA TECH SAMPLE LOCATION
URS SAMPLE LOCATION (2006)
DAMES AND MOORE SAMPLE LOCATION (1995)
TETRA TECH SAMPLE LOCATION (1990)
RWM SAMPLE LOCATIONS (1984)
PERATROVICH, NOTTINGHAM & DRAGE SAMPLE LOCATIONS (1999)
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NOTE
- HAZARD QUOTIENTS WERE BASED ON SEDIMENT CLEANUP OBJECTIVES SPECIFIED BY WASHINGTON STATE DEPARTMENT OF ECOLOGY. SEE TEXT FOR THE SPECIFIC METHODS OF CALCULATION
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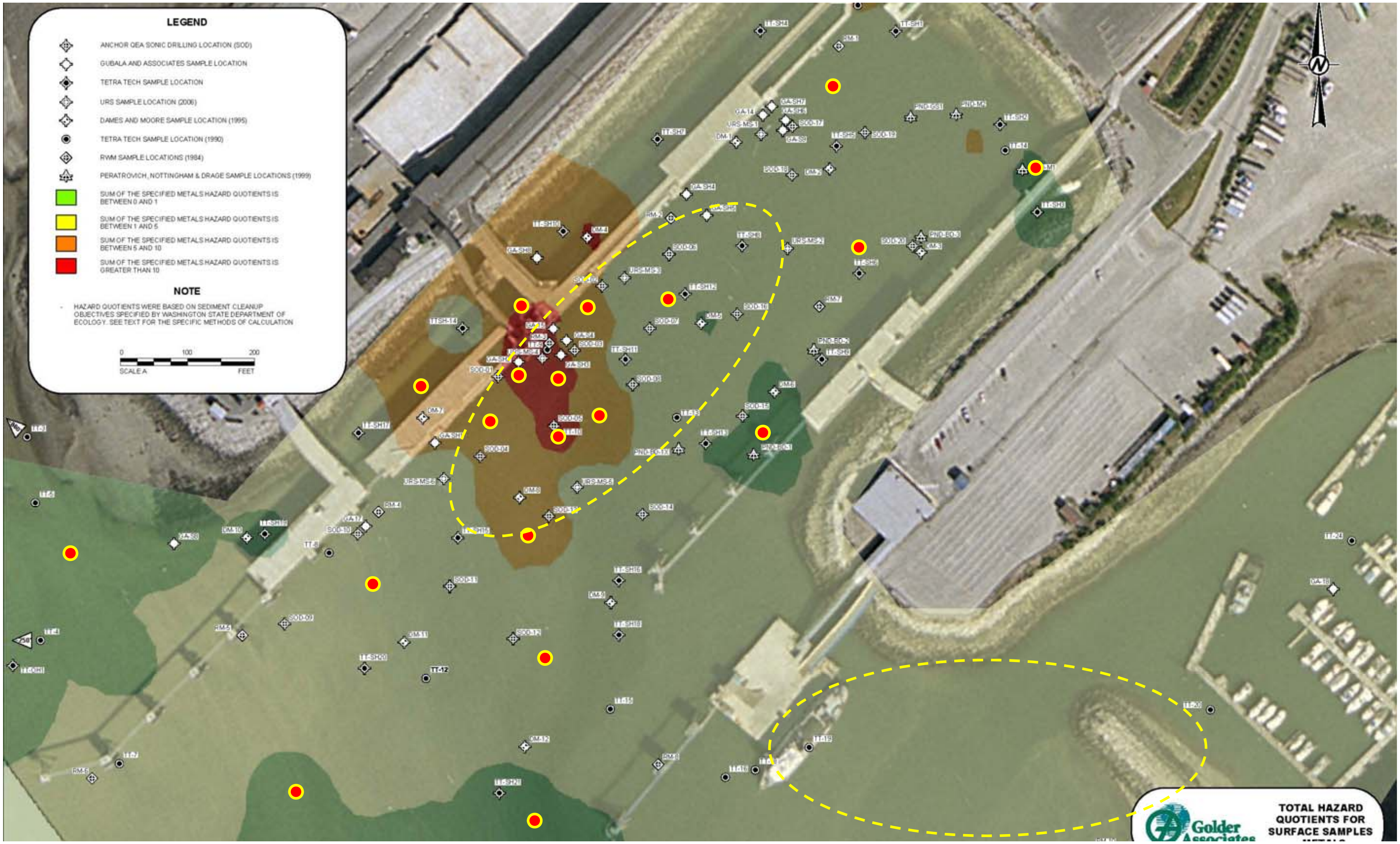
Golder Associates
TOTAL HAZARD QUOTIENTS FOR NEAR SURFACE SAMPLES - METALS
FIGURE 5B



Proposed Sample Locations

Proposed Tissue Collection Area

CLIENT
WHITE PASS AND YUKON RAILWAY

PROJECT
STUDY DESIGN AND SAMPLING AND ANALYSIS PLAN
ORE BASIN, SKAGWAY, ALASKA

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-04-17
PREPARED	BGM
DESIGN	BGM
REVIEW	TJR
APPROVED	GL

TITLE
PROPOSED SAMPLE LOCATIONS

PROJECT No.	PHASE/TASK	Rev.	FIGURE
1657231	1000	1	6

APPENDIX B

Resumés for Qualified Environmental Professionals and Qualified Samplers

Education

MSc Toxicology, University of Guelph, Guelph, Ontario, 2013

BSc Environmental Toxicology (Major): Business Administration (Minor), University of Guelph, Guelph, Ontario, 2009

Certifications

Vancouver Island University - British Columbia Electrofishing Crew Lead Certification, 2015

Danatec Educational Services - H2S Awareness Certification, 2014

Alberta Construction Safety Association - Pipeline Construction Safety Training (PCST), 2014

Golder Associates - Bear Aware Certification, 2014

University of Guelph - Good Laboratory Practices Certification, 2010

Workplace Hazardous Materials Information System (WHMIS), 2010

St. John's Ambulance CPR-C, 2014

Golder Associates Ltd. – Vancouver

Environmental Scientist

Paddy McManus is an environmental scientist specializing in toxicology with seven years dedicated to the discipline. He has studied environmental fate, residue analysis, community ecology, chronic exposure toxicity monitoring and water chemistry.

Employment History

Golder Associates LTD. – Burnaby, BC

Environmental Scientist (2014 to Present)

Part of various teams conducting risk assessments, environmental monitoring, environmental permitting and environmental impact assessments. Proficient field researcher.

University of Guelph – Guelph, ON

Graduate Student (MSc Research) (2010 to 2013)

Identified questions arising from knowledge gaps in the literature regarding a new mosquito larvicide then designed experiments to address these questions. Worked in an NSERC industrial partnership to make meaningful and practical contributions to both academia and a Canadian startup company, resulting in new pesticide registrations and a new tool to combat malaria and dengue fever. Designed and conducted research on mesocosms at the Guelph Turfgrass Institute, then became proficient at aquatic testing related to research questions; including zooplankton classification, mosquito bioassay and quantification of chitin production. Paddy has extensive experience with trace chemical analysis in water and pond sediment using HPLC and spectroscopy as a result of this research.

University of Guelph – Guelph, ON

Graduate Teaching Assistant (2011 to 2013)

Held numerous teaching assistant placements, each with different demands such as facilitating student discussions, conducting lab sessions, providing constructive feedback, lecturing in class, and grading essays, tests and presentations. Was placed in a unique position to design and administer a course curriculum.

Mahkteshim - AGAN, Tumaini Inc., University of Guelph - Guelph, ON

Laboratory Technician and Project Manager (2009 to 2010)

Designed and conducted preliminary pesticide (Novaluron) characterization studies that led to a master's position. Presented data in a variety of mediums to industrial sponsors and senior staff for the duration of employment biweekly. Gained initial experienced in grant application writing, conducting ELISAs, developing chemical specific antibodies and HPLC analysis methods.

Health Canada – Ottawa, Ontario

Healthy Environments and Consumer Safety Branch Intern (2008 to 2008)

Worked in the Chemical Strategies Division to assess, evaluate and summarize literature that were used to make regulatory decisions about specific chemicals (like bisphenol A). Designed chemical regulations search strategy that was distributed and used by the entire division.

Public Health Agency of Canada – Guelph, Ontario
Research Associate (2007 to 2007)

Developed a new model for Campylobacter pathogenicity through the differential killing of the soil nematode C. elegans at the PHAC Laboratory for Foodborne Zoonosis. Maintenance of the lab department, including propagating bacterial cultures and C. elegans nematodes. Coordinated and designed experiments to solve pertinent research objectives which led to fundamental breakthroughs on the project. Presented results in a variety of formats on a regular basis to small groups of superiors with varying levels of knowledge on the project. Became adept at aseptic technique, DNA extraction, PCR, microscopic photography and cloning.

Health Canada – Ottawa, Ontario
Hazardous Materials Information Review Commission Literature Review Agent (2007 to 2007)

Worked in the Hazardous Materials Information Review Commission (HMIRC) to conduct a categorical search of literature available on a given chemical to ascertain toxicological importance. Screened through thousands of scientific journal article abstracts to collect pertinent information for policy decisions.

PROJECT EXPERIENCE – ENVIRONMENTAL MANAGEMENT

Vancouver Airport Fraser River Offshore Drilling Environmental Management Plan
British Columbia

Created an environmental management plan for future offshore drilling and sediment sampling to mitigate environmental disturbance and negative effects in accordance with applicable environmental regulations.

Various Environmental Monitoring Sites in the Vancouver Area
British Columbia

Served as site environmental monitor to various sites like building construction areas, land excavation zones, and movies sites in the vicinity of sensitive environments in the Vancouver area. Duties have consisted of thorough knowledge of the regulatory setting of the site, frequent communication with senior Golder staff and clients and careful attention to detail.

Sasamat Dam Geotechnical Investigation Environmental Management Plan
British Columbia

Created an environmental management plan for future onshore drilling and sediment sampling near water to mitigate environmental effects in accordance with applicable environmental regulations.

PROJECT EXPERIENCE – ENVIRONMENTAL ASSESSMENT

Britannia Mine Pore Water Monitoring
British Columbia

Pore water sampling and screening against applicable provincial and federal guidelines to assess the level of contamination in the environment surrounding a decommissioned mine.

Tilbury Foreshore Investigation
British Columbia

Created and implemented a work plan to evaluate areas of a site at high risk of containing contamination. Data was screened against applicable provincial guidelines to establish existing levels of environmental contamination prior to a lease transfer agreement.

Capital Regional District Environmental Assessment
British Columbia

Responsible for the statistical analysis, reporting and discussion of the semi-annual benthic macroinvertebrate assessment and sediment quality triad evaluation.

PROJECT EXPERIENCE – BIOLOGICAL SCIENCES

The Pier Development Site Permitting
British Columbia

Wrote numerous permits to address environmental impact mitigation, including a request for review to the DFO and Port Metro Vancouver project reviews for a development site in North Vancouver.

Trend Mine Environmental Effects Monitoring (EEM)
British Columbia

The environmental effects monitoring of Trend Mine involved several activities which Paddy was involved in:
- water and sediment sampling of effluent from the mine
- fish capture, sexing and assessment
- lentic ecosystem evaluation
- amphibian habitat reconnaissance
- data capture and screening against applicable provincial guidelines
- chlorophyll a quantification and statistical analysis

Kitimat Marine Terminal Barge Ramp Extension Sampling Program
British Columbia

Collected and characterized marine sediment for analysis chemistry and toxicology parameters. Facilitated communication between project managers and subcontractors in the field. Integral part of technical troubleshooting team.

Athabasca Oil Pipeline Construction Amphibian Conservation
Alberta

Reconstructed local habitats to mitigate pipeline construction activities. Sampled and collected species of special concern to determine effects of conservation efforts.

TRAINING

Site to Story: Technical Writing Workshop
Geoenvirologic, 2015

Statistical Methods in Ecotoxicology Using R
SETAC (Short Course), 2014

Canadian Aquatic Biomonitoring Network (CABIN) Field Assistant
University of New Brunswick and Canadian Rivers Institute, 2014

PROFESSIONAL AFFILIATIONS

Society of Environmental Chemistry and Toxicology (SETAC) (2005-present)

PUBLICATIONS

Characterization of a Formulation of Novaluron in Extended Field Trials, presented at the American Mosquito Control Association (AMCA) annual meeting, Atlantic City NJ, 2013 (Presentation)

Characterization of a Controlled-Release Formulation of Novaluron, presented at the American Mosquito Control Association (AMCA) annual meeting, Austin TX, 2012 (Presentation)

Novaluron as a Controlled-Release Insecticide, presented at the American Mosquito Control Association (AMCA) annual meeting, Austin TX, 2012 (Poster)

Characterization of a Controlled-Release Formulation of Novaluron, presented at the Society of Environmental Toxicology and Chemistry (SETAC) annual meeting, Boston MA, 2012 (Poster)

Characterization of Three Controlled-Release Formulations of Novaluron, 2010 (Report submitted to EPA and PMRA)

Education

Diploma Fish and Wildlife Technologist, Sir Sandford Fleming College, 2002

Golder Associates Ltd. – Whitehorse

Project Role: Senior Technician

Joe Marquardson is a Senior Technician in Golder's Whitehorse office where he has over 10 years of experience in environmental sampling including fisheries habitat assessment, baseline and construction related environmental monitoring and management, and hydrologic assessments including instream flow needs, water quality sampling. He has been involved in a variety of transportation, infrastructure and development projects.

Employment History

Golder Associates Ltd. – Calgary, AB then Whitehorse, YT

Senior Environmental Monitoring (2006 to Present)

Environmental Monitoring related to water quality, hydrology, water quantity, fisheries and aquatic ecosystem resource inventory. Expertise in leading field programs, equipment operation, remote field work, and field logistics.

Arctic Response – Whitehorse, YT

Instructor (2011 to Present)

Part time training instructor for courses such as Wilderness First Aid, Ice Rescue, Wilderness Survival, Snowmobile Safety and Roadside Emergency Preparedness.

Ontario Ministry of Natural Resources Lake Simcoe Fisheries Assessment Unit – Sutton, ON

Fisheries Technician (2005)

Fisheries technician for winter angler creel survey on large lake (750 km^2) receiving heavy sport fishing pressure.

Ontario Ministry of Natural Resources Upper Great Lakes Management Unit – Owen Sound, ON

Fisheries Technician (2005 to 2006)

Crew lead for fisheries assessment surveys. Responsibilities included data collection, equipment operation and maintenance and staff training. Participated in many field projects, such as off-shore index gillnetting, spawning assessments, larval walleye trawling, river flow monitoring, migratory salmonid fish-way monitoring, lake sturgeon sampling, commercial catch sampling, and forage fish surveys. Demonstrated proficiencies with fish bio-sampling including fish dissections and fish tissue sampling for contaminant analysis.

Ontario Ministry of Natural Resources Kawartha Lakes Fisheries Assessment Unit – Lindsay, ON

Fisheries Technician (2002 to 2003)

Assisted with fisheries assessment field surveys, such as gill and trap netting and summer and winter roving angler creel surveys. Responsible for data entry and laboratory duties, such as fish bio-sampling, dissections, collection of tissue for contaminant analysis and age structure preparation.

Laurentian Co-operative Freshwater Ecology Unit – Sudbury, Ontario

Fisheries Technician (2001)

Sampled fish communities of oligotrophic lakes in remote areas using gill and trap nets.

PROJECT EXPERIENCE – GENERAL

Gahcho Kue Environmental Assessment Northwest Territories June 2010 – August 2014	Water sampling, toxicology sampling, fish health, abundance and distribution assessments, hydrological assessments, deployed / retrieved water quality data logging sondes, assessed fish possibility potential for selected watercourses, benthic macro-invertebrate sampling, plankton sampling, large scale lacustrine fish salvage, collected depth integrated water samples from arctic lakes in winter. Accessed sites via helicopter and snow machine.
Snap Lake Aquatics Effects Monitoring Northwest Territories January 2009 – September 2016	Collect depth integrated water samples from arctic lakes in winter. Process large suites of water samples and send to multiple labs. Enter data in client database. Prepare safe work plans. Access sites via snowmobile, boat, Haggland. Lake trout mark and recapture study - angled and PIT tagged 250 lake trout for population estimate study. Deployed / retrieved water quality data logging sondes.
AEM Jennings Baseline Monitoring Rancheria, YT June 2011 – October 2013	Water sampling, fish habitat data collection, stream backpack electrofishing, install and maintain meteorological station and hydrological gauges, measure stream discharge, collect water, benthic macro-invertebrate and plankton samples. Summarized results, prepared reports, and project management.
WPYR Fish Habitat Compensation and Monitoring Bennett Lake, BC September 2011 – September 2016	Assisted with planning and design of fish habitat enhancement structures for Bennett Lake. Assisted with survey design to assess fish use of enhancements. Collected fish using electrofisher, seine net and minnow traps. Select suitable location for structure installation. Collect lake substrate and water level elevation.
Milk River Instream Flow Needs Study Milk River, AB July 2010 – October 2010	Used Real Time Kinematic survey equipment to produce detailed maps of bathymetry, riparian topography, fish habitat, and floodplain and stream characteristics for modelling. Measured stream discharge and ice cover.
Shell Canada Ltd. - Muskeg River Mine Expansion Fort McMurray, AB June 2006 – September 2008	Field crew lead for stream geomorphic study. Used Acoustic Doppler Current Profiler for bathymetry mapping and measuring stream discharge. Used Real Time Kinematic survey equipment to produce detailed maps of fish habitat, floodplain and stream characteristics for modelling. Collected fish and fish habitat data from surrogate streams.

Whitemud River Instream Flow Needs Study Winnipeg, MB October 2009	Used Real Time Kinematic survey equipment to produce detailed maps of fish habitat, floodplain and stream characteristics for modelling. Used Acoustic Doppler Current Profiler for bathymetry mapping and measuring stream discharge.
Diavik Diamond Mines Inc. Lac Des Gras, NT August 2008	Fish health study on lake trout comparing levels of mercury in two populations. Captured fish using angling, extracted various tissues for lab analysis and age determination.
Endako Mines Fraser Lake, BC September 2009	Field crew lead for water quality, fish health, and sediment sampling program. Collected various data for comparison of watercourses adjacent to mining operations to control sites not affected by mining. Collected sediment and water quality samples, selected sites, jet boating.
Suncor Energy Inc. Millennium Project Fort McMurray, AB July 2008-March 2009	Assessed fish habitat potential for tributaries to Steepbank River. Measured water quality and stream velocity during winter. Prepared report on fish utilization of habitat enhancements (groynes) in Steepbank River.
Canadian Natural Resources Ltd. - Horizon Project Fort McMurray, AB May 2006 – September 2009	Crew lead for installation and monitoring of migratory fish counting fences. Implanted passive integrated transponder (PIT) tags into sportfish and sucker species. Secondary crew lead for Tar River fish salvage. Operated portable tote-barge type electrofisher.
Town of Strathmore Strathmore, AB April 2009	Field crew lead for spring fish spawning assessment on Bow River. Used egg airlift sampler and kick sampling to delineate spawning habitat use of trout and sucker species. Conducted redd survey. Prepared report on results.
Shell Canada Limited (Shell) – Jackpine Mine Fort McMurray, AB May 2006 – September 2008	Field crew lead for fish and fish habitat monitoring during 2006 and 2007 seasonal field programs. Primary responsibilities included characterizing fish habitat and sampling fish to provide population estimates. Also responsible for supervision of crew of two to four field staff. Sampled fish using backpack and portable boat electofishers. Collected water quality data, sediment samples, benthic macroinvertebrates, sampled aquatic macrophytes, various limnological parameters.
Petro-Canada Fort Hills Athabasca Oil Sands Project (AOSP) Fort McMurray, AB June 2007 – August 2008	Collected water quality data and was the field crew lead for fish and fish habitat baseline study, construction monitoring, and fish salvage. Responsibilities included characterization of fish habitat and fish sampling to provide population estimates, monitoring of total suspended solids in watercourses subjected to construction activities, fish salvage using traps and electrofishers, and installation of fish barriers.
Syncrude Canada Inc. Aurora Mine Fort McMurray, AB June 2008	Conducted lake bathymetry and fish habitat mapping, set and fish wire minnow traps, and measured water quality.

TransAlta Utilities Bighorn Dam
Nordegg, AB
September 2008

Fall salmonid spawning assessment. Used egg-airlifter to delineate mountain whitefish spawning habitat utilization and conducted redd survey throughout a 40-km stretch of North Saskatchewan River. Salvaged fish during a scheduled outage, reported results.

Aguilla Exploration Consultants Limited
Inuvik, NT
January 2008 – February 2008

Crew lead for seismic blast monitoring. Measured pressure changes in Beaufort Sea resulting from dynamite blasts during a test program in winter.

Shell Unconventional Resource Extraction
Wabasca, AB
June 2007 – October 2010

Crew lead for pipeline and road crossing fish habitat assessments. Characterized fish habitat and sampled fish community using backpack and boat electrofishing and minnow traps. Baseline study of fish and fish habitat conditions prior to development involving electrofishing, water quality, assessment of various stream and waterbody characteristics.

Plains All American Pipeline L.P.
Sundre, AB
February 2009 – March 2009

Field crew lead for sediment and construction monitoring during horizontal directional drill under Red Deer River during winter. Monitored water for total suspended solids and turbidity through ice at various locations during drilling activity.

Lake Huron Baitfish Study
Lake Huron, ON
June 2004 – July 2004

Crew lead for lake-wide forage fish assessment. Captured small fish using minnow traps, fyke nets, and gill nets. Identified fish using taxonomic keys. Trained staff and volunteers.

Georgian Bay Muskellunge Index Netting
Lake Huron, ON
April 2003 – May 2005

Crew lead for health and abundance netting program. Captured spawning muskellunge using nearshore trapnets at known and suspected spawning locations. Collected gametes and tissue for aging, genetics, and disease analysis, assisted with site selection.

Severn Sound Walleye Spawning Assessment
Lake Huron, ON
April 2003 – May 2005

Crew lead for walleye health and abundance netting program. Captured spawning walleye using nearshore trapnets near known spawning locations. Collected age structures, biological measurements, and applied Floy tags. Collected fish tissue for contaminant sampling.

Kawartha Lakes Fish Health and Abundance Study
Lindsay ON
May 2002 – September 2002

Captured fish with trap and gill nets. Tissue sampling for contaminants, age structure, sex/maturity, various biological measurements, meristics and observations.

Moon River Walleye Spawning Assessment
Lake Huron, ON
May 2005

Captured spawning walleye for health and abundance assessment using nearshore trapnets. Measured river velocity, measured water levels using surveying equipment, captured larval fish using tow nets, and quantified use of natural and introduced spawning substrate using spotlights.

Lake Huron Double-Crested Cormorant Impact Study
Lake Huron, ON
June 2003 – September 2003

Crew lead for impact assessment of Cormorant predation on nearshore fish communities using trap and gill nets. Trained staff. Collected fish tissue for aging and contaminant sampling.

Lake Huron Commercial Catch Sampling
Lake Huron, ON
June 2004 – September 2004

Organized trips with commercial fishermen. Counted and biosampled commercial catch on-board commercial fishing vessels. Trained staff.

Lake Huron Lake Sturgeon Assessment
Lake Huron, ON
June 2004

Used gill nets and set lines and dip nets to capture spawning lake sturgeon. Sampled commercially caught sturgeon held in hatchery race-ways.

Owen Sound Bay Lake Trout Spawning Assessment
Owen Sound Bay, ON
September 2003 – November 2005

Crew lead. Set short-duration small mesh gill net sets on known and suspected spawning shoals at night.

Algonquin Park Wolf Research
Algonquin Park, ON
January 2004 – April 2004

Conducted radio-telemetry study to determine population estimates, pack size and territory, mortality, and migration. Located wolf packs using aerial radio-telemetry, uploaded and interpreted data from global positioning system (GPS) collars, determined health of wolf-killed moose, and determined cause of death for collard wolves. Also participated in aerial white-tailed deer winter habitat delineation and moose hair-loss severity surveys.

Giant Mine Fish Health
July 2012

Captured small bodied fish using backpack electrofisher, minnow traps, sene nets. Performed necropsies on ninespine stickleback, collected tissue samples for toxicology.

TRAINING

All Terrain Vehicle Safety and Operation-Alberta Safety Council

Snowmobile Safety and Operation - Golder

Construction Safety Training System-AB Construction Safety Assoc.

Valid Class 5 Yukon Driver's License

YSI calibration, maintenance and troubleshooting-Hoskin Scientific

Fishes of Ontario Identification-Royal Ontario Museum

Valid Class Two Electrofishing Certificate-Fleming College, Malaspina College

Valid First Aid and CPR-Lifesaving Society; maintained since 1999

Pleasure Craft Operator Card-Lifesaving Society

Working on Ice, Ice Safety, and Rescue-Risk Dynamics

Marine Emergency Duties (MED-A3)-Georgian College

Restricted Aeronautical Radio Operator Certificate-Sir Stanford Fleming College

Bear Safety Awareness-Ontario Ministry of Natural Res. (OMNR) Golder

Workplace Hazardous Materials Information Systems-OMNR, Golder

Transportation of Dangerous Goods-OMNR, Golder

Chainsaw Safety-Landscape Ontario

Firearms Safety-Firearms License

Oil Sands Safety Assoc. (OSSA) Regional Orientation Program

H2S Alive-Encore

Education

Masters of Environmental Toxicology, Simon Fraser University, Burnaby, BC, 2004

Post-Baccalaureate Diploma in Environmental Sciences, Capilano College, North Vancouver, BC, 1997

BSc Ecology, University of British Columbia, Vancouver, BC, 1996

Golder Associates Ltd. – Vancouver

Employment History

Golder Associates Ltd. – Burnaby, BC

Associate, Senior Environmental Scientist (2008 (Associate, 2012) to Present)

Project director and principal investigator for contaminated sites investigations, quantitative ecological risk assessments and specialized environmental toxicology projects. Responsible for designing studies to address project needs, providing oversight to field teams, reviewing study deliverables, and preparing technical reports. Also responsible for client and regulatory liaison as well as project budgeting and financial management.

Simon Fraser University – Burnaby, BC

Sessional Lecturer (2003 to Current)

Responsible for the delivery of 50% of graduate course offered as part of the Masters of Environmental Toxicology program. Course content focuses on study design and interpretation of data for environmental toxicology and risk assessment projects undertaken to provide practical solutions for contaminated site management.

Golder Associates Ltd. / EVS Environment Consultants – North Vancouver, BC

Environmental Scientist (2000 to 2008)

Duties included study design, data analysis, reporting, and project management. Acted as Principal Investigator for projects involving ecological risk assessment and/or environmental toxicology.

EVS Environment Consultants – North Vancouver, BC

Laboratory Biologist (1998 to 2000)

Conducted routine and specialised toxicity testing with broad range of taxonomic groups and environmental media.

PROJECT EXPERIENCE – CONTAMINATED LAND REMEDIATION

Site Investigation and Remedial Services for Imperial Oil
British Columbia, AB

Acted as group leader and senior project manager for a 20+ person team of scientists and engineers providing site investigation, risk assessment and remediation services for a portfolio of 150+ sites across Western Canada. Projects ranged in size and complexity, but covered service stations, cardlocks, bulk plants and fertilizer storage facilities. Services focused on site closure planning, groundwater and soil sampling, soil vapour sampling, water use determinations, remedial action planning, ex-situ remediation, risk assessment and demolition. Typical project values ranged from $25,000 - $250,000 per site per year with an aggregrate spend of greater than $3M per year.

Former Bulk Plant and Cardlock, Houston
British Columbia

Project director for site characterization and closure of a former bulk plant and cardlock in Houston, BC. A site investigation strategy was designed to meet the requirements of the Contaminated Sites Regulation, and targeted soil remediation was completed to remove petroleum hydrocarbons in soil. A numerical Certificate of Compliance was obtained.

Former Service Station, Prince George
British Columbia

Project director and principal risk assessor for site characterization and risk-based closure of a former gas station in Prince George, BC. The primary challenge was that the water table was extremely deep, and contained elevated concentrations of selenium. An approach to obtain a local background release was negotiated with the Ministry and ultimately, a risk-based Certificate of Compliance was obtained.

Former Townsite, Port Moody
British Columbia

Project director and principal risk assessor for site characterization and risk-based closure of a former townsite (1912 - circa 1950) associated with the former IOCO Refinery in Port Moody BC. The site was previously occupied by residences with oil heating tanks, resulting in hydrocarbon and metal contamination in soil. Regulatory instruments were needed to support the property transfer. Designed a site investigation strategy that focused on contamination on a site-wide basis (i.e., a meta-AEC) instead of as a series of individual point-sources. Negotiated an approach to aggregrate large numbers of individual legal titles into five distinct parcels. Focused on obtaining background releases so that remediation focused on site-specific contaminants related to historical site activity. Executed a soil remedial program in conjunction with a Protocol 13 screening-level risk assessment. Certificates of compliances were obtained.

Former Bulk Plant, Richmond
British Columbia

Project director and principal risk assessor for site characterization and risk-based closure of a former bulk plant located adjacent to the Fraser River in Richmond, BC. The site was located on a former intertidal zone that was historically occupied by a fish cannery, resulting in anomalous metals (tin, mercury) at depth, as well as petroleum hydrocarbons in soil and groundwater. A site characterization program was executed that delineate the contamination in soil, groundwater and a sediment. A remedial program was initiated to remove petroleum hydrocarbon contamination at depth which required the design and installation of a sheet pile wall to depth of 13 meters. A detailed ecological and human health risk assessment was completed for the residual contamination that could not be removed due to the proximity of the Fraser River. This included a sediment risk assessment to allow the water lots to be returned to the Vancouver Fraser Port Authority. A risk-based Certificate of Compliance was obtained.

Former Bulk Plant, 100 Mile House
British Columbia

Project director and principal risk assessor for site characterization and risk-based closure of a former bulk plant located adjacent to agricultural land in 100 Mile House, BC. Site investigation found residual hydrocarbons and metals were present in soil; a previous consultant obtained an Approval in Principle that required remediation of significant volumes of soil. A supplemental investigation was executed that confirmed that residual contamination presented minimal risks using Protocol 13. A risk-based Certificate of Compliance was obtained.

Former Bulk Plant, Port Alberni
British Columbia

Project director and principal risk assessor for site characterization and risk-based closure of a former bulk plant located adjacent to Alberni Inlet. Site investigation identified petroleum hydrocarbons in fractured bedrock. The subsequent risk assessment focused on evaluating risks in seepage water along the shoreline; upland risks from residual soil contamination were evaluated using the typical Health Canada HHRA model and Protocol 13. The property included a sediment water lot, which required a detailed ecological risk assessment. The ERA used toxicity testing and sediment transport analysis to place risks from hydrocarbons in the context of risks associated with neighbouring properties, which included a pulp and paper mill outfall. A risk-based Certificate of Compliance was obtained.

PROJECT EXPERIENCE – RISK

Guidance Manual for Detailed Ecological Risk Assessments
British Columbia

Project Manager and co-author of a guidance manual for conducting detailed ecological risk assessments in British Columbia. This guidance manual was adopted as Protocol 20 under the Contaminated Sites Regulation and forms the basis for obtaining risk-based Certificates of Compliance. The manual provided a state-of-the-science update and expansion of the existing Tier I framework and emphasised the need to evaluate sites based on their ecological attributes rather than land use alone. Specific guidance was provided on the development of comprehensive and defensible problem formulations. Detailed guidance was also provided on numerous risk assessment tools, including the appropriate use of toxicity testing, improving consideration of bioavailability, developing relevant toxicity reference values, and using weight-of-evidence approaches for risk characterisation.

Sediment and Groundwater Risk Assessment, Former IOCO Refinery
British Columbia

Project director for a multi-year detailed ecological risk assessment for the shoreline of a former refinery (which is still an active distribution terminal). Historical activities resulted in the presence of LNAPL bodies near the receiving environment, leading to dissolved phase hydrocarbons in groundwater as well as sediment contamination. Developed a tiered strategy that started with a detailed LNAPL mobility assessment and a distributed temperature sensing study to identify and prioritize groundwater seepage areas, followed by groundwater-surface water modelling and deployment of passive samplers to provide a realistic measure of exposure. Exposure data were compared to site-specific toxicity reference values. Sediment was assessed using sediment profile imaging. A detailed risk assessment was developed using all available lines of evidence in a weight-of-evidence framework.

Risk Management and Remediation Planning for the Former IOCO Refinery
British Columbia

Project director for a multi-year (2009 - current) integrated site characterization, risk assessment and remedial planning for a 200 hectare former refinery site. Responsible for the development of the overall site risk management strategy and leadership of a multi-disciplinary team, including site characterization, hydrogeology, geo-chemistry, environmental toxicology and risk assessment, marine engineering, ecology and stream restoration, remedial options analysis, remedial design, and project management. Responsible for study design and client and regulatory liaison.

Harbour-Wide Sediment Risk Assessment
Esquimalt, BC

Provided peer-review and technical assistance to the study team contracted by the Department of National Defence to complete a sediment assessment and management program for Esquimalt Harbour. Activities included participation in a Senior Review Panel examining study design and problem formulation documents prepared by a third party; providing technical assistance to the study team during project implementation, and design of a decision-making framework that will be used to integrate the results of a sediment, wildlife and human health risk assessment into an overall risk management strategy for the harbour.

Sediment ERAs for Former Imperial Oil Fuelling Facilities
British Columbia

Project manager and principal investigator for a major oil & gas client in process of divesting a portfolio of former marine fuelling facilities. A framework for sediment assessment and management decision-making was developed based on weight-of-evidence principles to provide a consistent sampling and interpretation strategy for multiple risk assessments. This framework was applied to seven different locations in British Columbia. Responsible for all aspects of study design, project implementation, interpretation, and regulatory liaison, including the preparation of submissions to obtain Certificates of Compliance.

Lead-Shot Food Chain Modeling
New Zealand, Australia

Project manager for the development of a mechanistic food chain model to evaluate the risks of lead shot on agricultural lands used by cattle. The food chain model was constructed using probabilistic techniques so that it could be used to evaluate a portfolio of potential sites by local regulators.

Sediment Ecological and Human Health Risk Assessment
Uranium City, SK

Project manager for a sediment EHHRA conducted for a former public port facility in Lake Athabasca, SK. The uplands portion of the site was remediated and decommissioned; however, historical site activities resulted in elevated hydrocarbon concentrations over a broad portion of the bay. Principal investigator for the ecological component, which included an extensive site characterization, toxicity testing, benthic community structure, elutriate chemistry and toxicity, and sediment transport analysis. The EHHRA formed the basis of a management plan for the site that emphasized non-intrusive techniques instead of wide-scale dredging.

Risk Assessment for Truck Repair Facility
Northeast BC

Project manager and principal investigator for a risk assessment for a former truck repair facility near Fort St. John, BC with elevated concentrations of metals and hydrocarbons in soil. A human health risk assessment and a terrestrial risk assessment was completed as part of a due diligence exercise associated with a property transfer. A Certificate of Compliance was issued for the site.

Development of Weight-of-Evidence Framework for Oil-Spill Risk Assessments
Wabamun Lake, AB

A train derailment resulted in the release of hydrocarbons to Wabamun Lake which required a comprehensive multi-year environment assessment in conjunction with a spill response and remedial program. A weight-of-evidence framework was developed to integrate the findings from 38 different lines-of-evidence into an overall conclusion about the magnitude of effects in different portions of the lake. A transparent framework that considered the representativeness, methodological robustness, clarity of interpretation, permanence of effects, causality, and coherence was an integral part of addressing regulatory concerns for the project.

Groundwater Risk Assessment
Vancouver, BC

Project manager and principal investigator for a groundwater risk assessment for discharges from an industrial property to Burrard Inlet. Tannins and lignins were identified as a likely toxicant related to historical site operation and infilling. The risk assessment used a combination of environmental toxicity testing, a site-specific ecological survey and consideration of groundwater attenuation models as part of a due diligence exercise by a major industrial client.

Groundwater and Sediment ERA for Former Shipyard Property
Confidential

Principal environmental toxicologist and risk assessor for an ongoing project (since 2001). A groundwater risk assessment based on a weight-of-evidence evaluation of a battery of toxicity tests was completed in 2002. A tiered sediment risk assessment was completed in 2004 to delineate the potential extent of sediment contamination, as well as any associated biological effects, including toxicity of sediment to marine life, alterations in the benthic community, and accumulation of contaminants in marine food chains. Key elements in the design of the sediment risk assessment included consideration of effects associated with a nearby combined sewer outfall, as well as other adjacent industrial properties and overall harbour background conditions. A battery of sediment toxicity tests (including chronic amphipod toxicity testing), and benthic taxonomy was completed. Ongoing investigations are focused on establishing the cause of toxicity observed in intertidal seepage areas and the development of a cost-effective risk management strategy.

Riparian Area ERA for Former Mining Area
Southeast British Columbia

A screening-level ERA was completed for a golf course expansion project proposed for an undeveloped land parcel containing several fish-bearing watercourses that were potentially impacted by historical mining activity. Lines of evidence included comparison of the available sediment and surface water chemistry data to applicable numerical standards, comparison of fish tissue chemistry to relevant toxicity reference values from the literature, statistical analyses of benthic community samples collected from on-site and upstream reference locations, and the construction of a food chain model to evaluate potential impacts to wildlife consuming dietary items and water from the creeks and the surrounding riparian areas.

Weight-of-Evidence Assessment of Selenium Impacts
Alberta

A weight-of-evidence assessment was conducted for an Albertan watershed potentially impacted by selenium releases from coal mining operations. A systematic compilation and evaluation of available data was conducted. Specific tasks for this project included the development of the weight of evidence framework. Lines of evidence included data from water, sediment, and fish tissue analyses as well as reproductive fish toxicity testing. Each line of evidence was critically evaluated with respect to its ability to support an ecologically relevant assessment—in the majority of instances, the available data were not sufficient to conclude that adverse ecological impacts at the population and watershed levels were in fact occurring. The current approaches described in the literature were critically reviewed with respect to their ecological relevance, and recommendations for improvements were provided.

Groundwater and Terrestrial ERA for the Dockside Lands
Victoria, BC

A groundwater and terrestrial ERA was completed for a large industrial land parcel being redeveloped for residential/commercial uses. The site was historically used for shipyard activities, freight and railway operations, asphalt manufacturing, and metal recycling, which resulted in elevated soil and groundwater concentrations of metals and polycyclic aromatic hydrocarbons (PAHs). Risks to soil invertebrates and plants were evaluated using a hazard quotient approach as well as site-specific earthworm and grass toxicity testing. Risks to small mammals and birds were evaluated using a food chain model and site-specific bioaccumulation factors (BAFs) developed from 28-d earthworm and grass bioaccumulation testing with site soils. A battery of groundwater toxicity tests was applied, using test organisms (giant kelp, bivalve larvae, and larval fish) intended to represent multiple components of the aquatic community present in the nearby marine receiving environment. Sediment-dwelling organisms were not evaluated. A weight-of-evidence assessment of the available groundwater toxicity and chemistry data was completed.

Screening-Level Aquatic ERA for Zinc and Chloride
Yellowknife, NT

Site-specific zinc and chloride discharge permit values to protect aquatic resources were derived for the EKATI Diamond Mine (located 300 km northeast of Yellowknife) in lieu of using ambient surface water criteria as the basis for mine permitting. Site-specific species sensitivity distributions (SSDs) were created for zinc and chloride, based on a comprehensive review of all available literature data. Species were selected to reflect the unique assemblage of taxonomic groups present in Arctic water bodies (in general) and the study area (in specific). Metal-specific issues were also addressed with respect to zinc, including the use of metal speciation modelling to assess the true bioavailable fraction (instead of total or dissolved concentrations). Toxicity data also reflected the naturally low water hardness values common to Arctic oligotrophic waterbodies. SSDs were used to calculate acute and chronic hazard concentrations intended to protect 95% of the site-specific species assemblages as a result of exposure to zinc and chloride. Overall risks to aquatic life were estimated to be negligible. Data from the available biological monitoring programs at the EKATI Mine were also reviewed, and found to support this conclusion.

Sediment ERA for the Former Versatile Shipyard Property
North Vancouver, BC

A supplemental marine sediment sampling program was conducted to reduce the uncertainty regarding potential risks to benthic organisms identified in previous site investigations. A comprehensive sediment toxicity program was completed for targeted portions of the site, including the use of a chronic amphipod bioassay (28-d Leptocheirus survival, growth, and reproduction), in addition to toxicity tests normally applied. Significant relationships between observed toxicity and the majority of contaminants concentrations were not identified; for those combinations that demonstrated a significant relationship, a detailed review of the cause-effect relationships was completed, and the implications for site management discussed. The supplemental sediment investigation also evaluated other issues that contributed to the uncertainty in the previous site investigation. Petrographic analyses were used to evaluate the hypothesis that elevated PAH concentrations were the result of the deposition of coal. The potential effects of TBT were also evaluated with a combination of predictive bioaccumulation models and literature-based toxicity reference values.

Terrestrial and Groundwater ERA for Southeast False Creek
Vancouver, BC

Multiple industrial activities along the southeast shoreline of False Creek over the past 100 years have led to elevated soil and groundwater concentrations of metals and hydrocarbons. The terrestrial ERA included acute soil toxicity testing (seed germination and root elongation), as well as dual-species (grass and earthworm) bioaccumulation testing. Bioaccumulation data were used to develop site-specific bioaccumulation factors (BAFs) for metals and hydrocarbons, which provided a more ecologically relevant estimate of contaminant uptake than the use of literature-based BAFs. A food chain model was used to estimate risks to birds and small mammals exposed through dietary pathways; the model was also used to evaluate potential risk management strategies, including limited soil remediation and various soil capping depths. The groundwater ERA used a battery of toxicity tests (three-spined stickleback, bivalves, giant kelp germination, and larval fish). Site-specific groundwater standards for PAHs were derived to reflect the low probability of PAH phototoxicity, based on site turbidity and orientation. A weight-of-evidence framework was used to assess the overall risks to marine organisms as a result of groundwater discharges from the site.

Screening-Level ERA for a Former Plant Nursery
Washington, DC

A large nursery site adjacent to the Anacostia River was designated for parkland redevelopment. The site has been subject to numerous historical impacts, including the deposition of dredged sediment to build up lowland areas near the river, plant nursery operations, and surrounding industrial activities. Risks were estimated using a hazard quotient approach for a broad selection of ecological receptors, including soil invertebrates and plants, aquatic life, benthic invertebrates, amphibians, small mammals and birds, and piscivorous birds. A wide range of potential contaminants consistent with historical site uses were evaluated, including metals, hydrocarbons, pesticides, phthalates, and chlorophenols. This screening-level ERA was intended to provide a desktop-level exercise to prioritize future baseline ERA sampling activities.

Groundwater and Sediment ERA for Canadian Coast Base
Victoria, BC

A preliminary quantitative ERA was completed to assist the site owner develop a long-term site management plan for the Victoria Coast Guard base. The groundwater ERA involved toxicity testing using giant kelp and bivalves; uncertainty regarding groundwater discharge locations and the influence of tide cycles and seasonal trends on groundwater contaminant concentration was identified for future investigation. The sediment ERA involved toxicity testing using amphipods and bivalves. The potential for TBT bioaccumulation was also qualitatively evaluated using empirical bioaccumulation models based on data obtained from other urban harbour sites. A qualitative exposure pathway analysis suggested risks to terrestrial receptors (soil invertebrates, plants, birds, and small mammals) under the current land use are negligible, with the potential exception of areas not currently covered by an impervious surface.

Screening-Level ERA for Point Atkinson / Lighthouse Park
West Vancouver, BC

Historical operation of the Point Atkinson lightstation resulted in elevated soil concentrations of metals (e.g., arsenic, lead, and mercury) in several areas of Lighthouse Park. A problem formulation workshop was completed, which brought together interested stakeholder groups, including regulatory agencies and the City of West Vancouver. The workshop facilitated community input regarding the scope of the project and was an essential component in the development of an ERA strategy for Point Atkinson and Lighthouse Park. An ERA for the entire park was completed, which involved an extensive sampling program for metal concentrations in soil invertebrates, vegetation, surface water, and mussel tissue. Risks to aquatic life were assessed with an exposure pathway analysis, while risks to populations of terrestrial organisms were assessed using a mechanistic food chain model. This food chain model also considered potential risks to rare and endangered species, as well as dogs visiting the site.

Groundwater ERA for a Former Gas Station
Cordova Bay, BC

Hydrocarbon-contaminated groundwater from a former gas station was discharging to a nearby beach environment. Although active remediation was underway, an ERA was necessary to assess the residual risks potentially present when remediation was completed. Chemistry and toxicity data for both the groundwater as well as intertidal beach sediment within the potential impact zone were collected and interpreted using a weight of evidence approach. A subtidal biophysical inventory was also completed with the assistance of a subconsultant. Adverse effects associated with the presence of elevated iron concentrations in groundwater were identified (which occurred due to increased microbial activity associated with hydrocarbon contamination); however, a review of the speciation of iron suggested any impacts under field conditions would likely be minimal.

Sediment Quality Assessment for a Refinery Discharge
Wisconsin

Process water from a refinery is currently discharged to a low-gradient stream that also acts as a stormwater drainage channel for a downstream urban area. Contradictory conclusions regarding the potential impacts of refinery operation on the stream and its floodplain (as well as the necessary scope of remedial activities) were obtained in multiple site investigations conducted since 1990. All available chemistry, toxicity, and benthic community data were compiled and critically reviewed in order to identify QA/QC issues that might limit the utility of the data for ERA purposes. A problem formulation was prepared, which identified multiple sources, contaminants, exposure pathways, and receptors not identified in previous assessments. An integrated assessment of potential ecological risks associated with elevated hydrocarbons in stream sediment was completed using a weight-of-evidence framework and all available site data. Data gaps for a human health and ecological risk assessment for the stream’s floodplain were also identified, and the limitations of the available data to support environmental management purposes were discussed.

Terrestrial and Groundwater ERA for a Former Sawmill Property
New Westminster, BC

A terrestrial and aquatic ERA was completed as part of a redevelopment plan for a former sawmill site on the North Arm of the Fraser River. Historic sawmill operation resulted in the release of several contaminants, including dioxins, furans, chlorophenols, and hydrocarbons. The objective of the terrestrial ERA was to evaluate the potential risks for the residual chlorophenol soil concentrations anticipated to remain on site, and was based on dual-species (grass and earthworm) bioaccumulation testing, and a mechanistic food chain model used to predict risks to birds and small mammals exposed to chlorophenol through dietary exposure under a future parkland land use scenario. The aquatic ERA involved a battery of toxicity testing using a number of different trophic levels and toxicological endpoints, including algal growth and water flea survival. Sediment exposure pathways were evaluated based on sediment chemistry and toxicity to amphipods and oligochaetes. A weight-of-evidence framework was used to assess the overall risks to aquatic organisms as a result of groundwater discharges or sediment exposure at the site.

Terrestrial ERA for Former Shooting Range
Confidential

Elevated soil concentrations of lead, PAHs, and other metals were discovered on an undeveloped, mature forest property in the Greater Vancouver area. Elevated soil concentrations resulted from spent shot and clay target fragments from a private shooting range which operated during the 1930s and 1940s. Metal and PAH concentrations in soil and surface water, berries, ferns, and leaves were measured, and an earthworm bioaccumulation test on site soil samples was conducted since soil invertebrates were not available at the time of sampling. Mechanistic food chain models, with increasingly realistic parameters, were constructed in order to estimate the potential risks to a variety of selected receptor species, such as shrew, mice, voles, deer, robins, and chickadees. Additionally, an extensive review of the methods and assumptions used in the derivation of an avian toxicity reference value for lead was completed, which resulted in several modifications to the food chain model to increase its ecological relevance, including adjustments that reflected the bioavailability of lead under field conditions.

Sediment Quality Investigation for the 2000 Olympics Site
Sydney, Australia

A review of sediment data collected by previous consultants for locations adjacent to the site of the 2000 Summer Olympic Games was requested by the Olympic Coordination Authority (now the Sydney Olympic Park Authority). Data were compiled and interpreted using a sediment quality triad approach, leading to a report regarding potential impacts of sediment contamination on the benthic community, within in the context of harbour-wide conditions. Recommendations for the design and implementation of future investigations were provided, and the limitations of the previous data collection and analytical methods were discussed.

Risk Assessment Strategy for Staffed Lightstations
British Columbia

Twenty-seven staffed lightstations operate along the British Columbia coastline, some of which have been operational for over 125 years. Metals and hydrocarbons in soil and groundwater were identified as potential concerns as a result of historical use of metals-based paints, fuel storage, on-site incineration, and on-site waste disposal. EVS (now Golder Associates) was the lead firm (of four firms involved) in the design and implementation of an ERA strategy. Phase II ESAs for each lightstation were compiled and audited. A data matrix was constructed to identify priority contaminants, sources, exposure pathways. Risk-based remediation objectives were developed as an alternative to generic environmental quality guidelines. A strategy document was prepared to guide the risk assessment process, including a comprehensive problem formulation based on the risk issues matrix, conceptual models, a tiered assessment strategy, and guidance for developing a detailed sampling and analysis plan. Appropriate site-specific remediation targets and risk calculations were also included. Duties for this project involved the creation and maintenance of the data matrix used to prioritise contaminants, sources, exposure pathways, and the selection of specific lightstations for further assessment.

Terrestrial and Groundwater ERA for CPR Railyards
Revelstoke and Nelson, BC

A problem formulation document was prepared for each railyard to identify site-specific contaminants (typically hydrocarbons and metals) associated with railway operations. Risks to aquatic receptors in adjacent receiving environments were evaluated by comparing modelled COPC concentrations in the aquatic environment to selected toxicity reference values. The available soil chemistry was compared to numerical standards for protection of soil invertebrates and plants, and an on-site qualitative assessment of potential impacts to the plant community was completed. A tiered approach was used for the overall risk assessment, including analyses of exposure pathways, community health and structure, toxicity tests, bioaccumulation studies, and contaminant transport modelling. Tasks for this project involved compilation of data and comparison of the available chemistry data to numerical standards.

PROJECT EXPERIENCE – ENVIRONMENTAL TOXICOLOGY

Toxicity Assessment for Mine Effluent Treatment Process
Confidential

Provided expert toxicological support for an ongoing evaluation and upgrade for effluent treatment at a gold mine in South America. An evaluation of historical chemistry data identified multiple substances in the discharge that required management actions. A temporary toxicity testing facility using 96-h rainbow trout survival tests was established in conjunction with a pilot-scale treatment plant to provide confirmatory data regarding the success of various process modifications. Data from the pilot-scale testing was evaluated using a toxic units approach to prioritize a small number of substances for further evaluation.

Selenium Tissue Residue Threshold for Dolly Varden Char
Northgate Minerals

Principal investigator and project manager for a multi-year investigation for developing a tissue residue threshold for Dolly Varden char (Salvelinus malma) at the Kemess Mine. The threshold value was intended for the basis of evaluating the success of proposed risk management actions for the mine instead of relying on generic water or tissue guidelines. Tasks included development of a study design, coordination of the project team, data interpretation and reporting. The resulting EC10-based threshold was considerably higher than those derived for other cold water salmonids and illustrates the value of completing site-specific studies.

Acute Effects of Iron and Molybdenum in Hydrocarbon-Contaminated Groundwater
Confidential

Principal investigator and project manager for an ongoing investigation for a former oil refinery that demonstrated sporadic acute toxicity to fish from the release of surface water from the site. Iron and molybdenum were identified as the likely toxicants based on consideration of the available data; this finding was confirmed through the use of bench-scale testing. Ongoing work involves the design of an effective water treatment system within the larger context of the site remediation plan.

Critical Review of Provincial Guidance for Deriving Soil Quality Standards

Conducted a critical review of the existing methods and guidance used by the BC Ministry of Environment to set soil quality criteria under the Contaminated Sites Regulation. Oversaw the ecological exposure pathways, such as protection of soil invertebrates and plants, groundwater flow to aquatic life, and livestock ingesting soil and fodder. A comprehensive review of existing guidance in other jurisdictions and the available scientific literature was conducted. Recommendations were made for the improvement and expansion of the existing derivation methods based on a number of technical issues, including the use of species sensitivity distributions, identification of appropriate toxicological data, endpoint selection, and allometric scaling. Review emphasised approaches to increase the utility of the standards though an improved focus on the bioavailability fraction of contaminants in soil.

Groundwater Toxicity Identification Evaluation (TIE) Program
Vancouver, BC

Designed and managed a TIE program to identify specific toxic compounds in a groundwater discharge. The program involved a baseline toxicity investigation using a battery of toxicity tests (20-min sea urchin fertilization; 48-h giant kelp germination and growth; 48-d bivalve larval development), followed by multiple TIE treatments using the 20-min sea urchin fertilization test. Treatments included EDTA chelation, thiosulphate chelation, solid phase extraction, aeration, pH adjustment, and open GC characterisation. The TIE program successfully identified compounds likely causing the observed groundwater toxicity.

Application of Porewater Toxicity Data in a Sediment Quality Triad Framework
Canada

Conducted a multi-year research project to evaluate the use of porewater toxicity testing (48-h bivalve larval development) within a sediment quality triad framework. Study design involved side-by-side testing of multiple samples collected from contaminated sites in Burrard Inlet and elsewhere. Specific issues that arose during the investigation included an assessment of the influence of naturally elevated ammonia concentrations in porewater samples. The ecological relevance of porewater sample collection and toxicity testing relative to in situ conditions was also examined in detail. Porewater toxicity testing using bivalves was not recommended for use as a routine component of the triad framework unless its ecological relevance could be demonstrated on a site-by-site basis. Existing regulatory threshold values for evaluating the influence of ammonia on Mytilus toxicity were found to be under-protective, and a revised value was proposed.

Critical Review of PAH Phototoxicity
Canada

Polycyclic aromatic hydrocarbons (PAHs) are a common contaminant in many urban areas. Some PAHs have the ability to absorb ultraviolet light (UV) energy; the photoactivated PAH causes damage to cellular membranes that can lead to biological impairment. An extensive literature review examining the ecological relevance of existing phototoxicity data was conducted. UV exposure in laboratory experiments is generally maximised by the use of environmentally unrealistic light sources (e.g., inappropriate photoperiods, wavelength distribution, and intensity); attenuation of light in the water column due to the lack of humic acid, dissolved organic carbon, and total suspended solids that absorb or block UV transmittal. PAH bioaccumulation in laboratory experiments is maximised through the use of water-only or spiked-sediment systems using a single PAH, often in conjunction with an organic solvent. Laboratory exposure systems also prevent test organisms from utilising behavioural adaptations to minimise the internal UV dose, such as the utilisation of refugia; laboratory-cultured organisms also lack resistance and/or tolerance mechanisms that may be present in natural populations. Although PAH phototoxicity should be considered, its potential impact should be evaluated as for any other contaminant—by considering source, exposure, pathway, receptor and effect on a site-by-site basis using an integrated approach with multiple lines of evidence. PAH phototoxicity should not be used for environmental management decisions until and unless ecological relevance is established, and then only as part of a weight of evidence determination.

Assessment of the Regulation of TSS under the Metal Mining Effluent Regulation
Canada

Participated in an investigation that summarised the effects of suspended sediment on fish and proposed an alternative methodology for controlling TSS releases under the Metal Mining Effluent Regulations (MMER). The review focused on evaluating the discrepancies between the Regulatory Impact Statement and the detailed justification for TSS control contained in previous regulatory documents. Revisions to the MMER that could be used to amend the TSS limits to reflect their use back into the context of the protection of fisheries. A simulation exercise based on the Eskay Creek Mine was also conducted: TSS discharge from the mine is in compliance with the TSS limit specified in provincial effluent permits, but would be in frequent non-compliance with the MMER. Despite this non-compliance, monitoring studies in the downstream environment show no evidence of acute or chronic effects in the receiving environment. A modified framework for the regulation of TSS at Canadian mines was developed to enable the retention of national consistency but allow the regulation to reflect regional difference in landscape, ecology, and other factors.

Global Review of Methodologies used to Derive Water Quality Guidelines
Canada

Authored a report for the Canadian Council of Ministers of the Environment outlining a global review of methodologies used to develop water quality criteria for the protection of aquatic life. This review was to assist CCME prepare an addendum to the existing Canadian water quality guidelines dealing with metal-specific issues such as the effect of naturally elevated background concentrations, synergism and antagonism, the use of total or dissolved concentrations, bioavailability, and the influence of toxicity-modifying factors such as pH and hardness. A global review of protocols currently used by “water quality developing” agencies at all levels (e.g., international, national, state/province) from jurisdictions around the world was conducted. A summary of the approaches from more than 15 jurisdictions was prepared, with emphasis on methodologies that provided an innovative approach to dealing with metal-specific issues.

Environmental Toxicity Testing and Toxicity Identification Evaluation
Canada

Highly experienced in the design, implementation, and interpretation of numerous environmental toxicity tests. Tests include (but are not limited to): 72-h algal reproduction test using Selenastrum capricornutum, acute sediment bioassays using a variety of marine and freshwater amphipods, chronic sediment bioassays using the polychaete Neanthes arenaceodentata and Leptocheirus plumulosus, 96-h acute toxicity tests using juvenile rainbow trout, 7-d chronic tests using early-life stages of rainbow trout, long-term bioaccumulation tests using the clam, Macoma nasuta, as well as soil toxicity testing involving seed germination, root elongation, and earthworm/plant bioaccumulation.

PROFESSIONAL AFFILIATIONS

Approved Professional (Risk), Contaminated Sites Approved Professional Society (CSAP)

Registered Professional Biologist RPBio (British Columbia)

Society of Environmental Toxicology and Chemistry

PUBLICATIONS

B.G. McDonald, A.M.H. deBruyn, J.R.F. Elphick, M. Davies, D. Bustard and P.M. Chapman. 2010. "Development toxicity of selenium to Dolly Varden char (Salvelinus malma)." Environ. Toxicol. Chem. 29: 2800-2805.

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McDonald, B.G and A.M.H. deBruyn. 2008. “Are rainbow trout the most sensitive species to selenium?” Integr. Environ. Assess. Manage. 4: 261-262. (Learned Discourse).

A.M.H. deBruyn, B.G. Wernick, C. Stefura, B.G. McDonald, B. Rudolph, L. Patterson and P.M. Chapman. 2007. In situ experimental assessment of lake whitefish development following a freshwater oil spill. Environ. Sci. Technol. 41: 6983-6989.

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Chapman, P.M., B.G. McDonald, P.E. Kickham, and S. McKinnon. 2006. “Global geographic differences in marine metals toxicity”. Mar. Poll. Bull. 52: 1081-1084.

deBruyn, A.D. and B.G. McDonald. 2006. “Empirical analysis of variability and statistical power in sediment toxicity tests.” Poster presentation, 27th Annual Meeting of the Society of Environmental Toxicology and Chemistry, Montreal, QC, 5 - 9 November 2006.

McDonald, B.G. 2005. “Comparison of porewater and elutriate bivalve larval development toxicity testing in a sediment quality triad framework.” Ecotox. Environ. Saf. 62: 893-890.

Chapman, P.M. and B.G. McDonald. 2004. “Using the Sediment Quality Triad in Ecological Risk Assessment” In: C. Blaise and J-F Férard (eds.), Small-Scale Freshwater Environment Toxicity Test Methods. Kluwer Academic Press, Netherlands.

McDonald, B.G and J. Wilcockson. 2003. “Improving the use of toxicity reference values in wildlife food chain modeling and ecological risk assessment.” Human Ecol. Risk Assess. 9: 1585-1594.

McDonald, B.G and P. Chapman. 2002. “PAH phototoxicity – An ecologically irrelevant phenomenon?” Mar. Poll. Bull. 44: 1321-1326.

Chapman, P., B.G McDonald, and G. Lawrence. 2002. “Weight of evidence issues and frameworks for sediment quality (and other) assessments.” Human Ecol. Risk Assess. 8: 1489-1515.

McDonald, B.G and P. Haynes. 2000. “The use of silica sand as a negative control in toxicity tests using Neanthes arenaceodentata.” Environ. Toxicol. 16: 172-176.

Education

MSc Contaminant Hydrogeology, University of Waterloo, Waterloo, ON, 2002

BSc Honours Earth Sciences (Hydrogeology), University of Waterloo, Waterloo, ON, 1995

Professional Affiliations

Association of Professional Engineers and Geoscientists of BC

Association of Professional Engineers and Geoscientists of NT and NU

Yukon Expert Roster of External Reviewers for Hydrogeological Assessments, Environmental Site Assessments and Remediation

Training

Prediction of Mine Drainage Chemistry, Natural Resources Canada

40 hour Hazwoper OSHA Training

PSMJ Project Management

Transportation of Dangerous Goods

Red Cross Standard First Aid and CPR-C, St. John's Ambulance

Golder Associates Ltd. – Whitehorse

Senior Hydrogeologist (2013 to present)

Ms. Tamra Reynolds is a Senior Hydrogeologist in Golder's Whitehorse office. She has over 20 years of experience in the areas of environmental site assessments, remediation, hydrogeological assessments, mine reclamation, and water supply projects throughout the Yukon, British Columbia, Northwest Territories, Alberta, Ontario, and Alaska. A 13-year resident of Whitehorse, Tamra is a professional geoscientist registered in British Columbia, Northwest Territories and Nunavut, and was appointed by the Yukon Government, Department of Environment to the Yukon Expert Roster of External Reviewers for Hydrogeological Assessments, Site Assessments and Remediation. Ms. Reynolds has 16 years of project management experience and has completed formal management training. She is well-versed with the current Yukon, British Columbia, Alaska and Canadian Federal regulations and has provided project submissions under the YESAB process. She provides effective project management, technical advice, senior review, data analysis, and interpretation. Her priorities when managing a project are health and safety, good communications with the client and project staff, keeping a project on budget, and providing deliverables to the client on time. In addition to providing project management, Tamra is currently Golder's Whitehorse Office Lead. In this role she oversees employee health and safety and training, manages the financial performance of the office, and develops and maintains strong client relationships.

Employment History

EBA, a Tetra Tech Company – Whitehorse, YT

Senior Hydrogeologist (2010 to Dec. 2012)

Provided technical advice, senior review, and mentorship to junior and intermediate staff. Project manager for environmental site investigations, large scale remediation, community water supply and mining assessments.

Franz Environmental – Whitehorse, YT

Senior Hydrogeologist (2008 to 2010)

Managed the Whitehorse office and projects based in the Yukon. Project work included environmental assessments in permafrost conditions at federal and territorial owned sites; complex remediation projects; and submission of remediation plans for YESAB approval.

Gardner Lee Limited – Whitehorse, YT

Senior Hydrogeologist (2004 to 2008)

Golder Associates Ltd. – Burnaby, BC

Intermediate Hydrogeologist (2002 to 2004)

Morrow Environmental Consultants Inc. – Burnaby, BC

Intermediate Hydrogeologist (1997 to 2002)

AGRA Earth and Environmental – London, ON

Junior Hydrogeologist (1995 to 1997)

PROJECT EXPERIENCE – ENVIRONMENTAL ASSESSMENT

Railway Yard and Former Wharf Tanks, WPYR Railroad
Skagway, AK, USA

Project Manager since 2013 providing regular updates to the client and regulator. Provided oversight of the on-going soil and groundwater sampling, additional drilling and test pitting to determine the source of TCE and PCE at the railyard site, and completed annual reporting for 2012 through 2015. At the former wharf tanks site, provided oversight of product recovery methods and annual reporting.

Yukon Environment, Dept. of Water Resources
Yukon Territory

Project Manager and report author for the development of groundwater sampling guidelines for contaminated sites in the Yukon. Project Manager and report author for water well construction guidelines for small drinking water wells that will be used in the Yukon.

Palace Grand Theatre, PWGSC, Dawson City, Yukon Territory

Project Manager for a Phase II ESA to investigate and delineate contamination originating from a former leaking storage tank including installation of monitoring wells and groundwater sampling in suprapermafrost. Responsible for setting up the field program, overseeing the field crew, reviewing the report, providing volume estimates, landfill options and costs for remediation and providing budget and schedule updates to the client.

Yukon Solid Waste Facilities
Yukon Territory

Project Manager for a bi-annual groundwater and surface water sampling program at seven solid waste facilities in southwest Yukon. In addition, completed hydrogeological summaries for 10 SWDF in support of Yukon Environment and Socio-economic Assessment Board (YESAB) applications for renewal of each facilities solid waste permit.

Former Garage and Service Station, Whitehorse, YT

Project Manager and report reviewer for the project which included the completion of a Phase II ESA, Remedial Options evaluation and Remediation Plan, Remedial Excavation, Off-site delineation drilling program, Post-remedial groundwater sampling and a Qualitative Human Health Ecological Risk Assessment.

Klondike Camp Highways Maintenance Yard
Dempster Highway, YT

Project Manager on various phases of assessment from 2004 to 2010. Drilling investigations were conducted across the site, located in areas characterized by discontinuous permafrost conditions from 2004 to 2006 where hydrocarbon contamination from spills and tank leaks, and salt contamination from storage was present. A revised Plan of Restoration was completed to address groundwater contamination entering the river and an impact and mitigation report was authored as part of the YESAB submission which was subsequently approved.

Beaver Creek RCMP Detachment
Beaver Creek, YT

Managed and conducted three drilling investigations to delineate a fuel spill in discontinuous permafrost conditions. Drilling was extended to over 30 m to vertically delineate contamination. The report included a remedial action/risk management plan.

Carcross RCMP Detachment
Carcross, YT

An additional Phase II ESA was completed to delineate a hydrocarbon plume. A final report was written which included a summary of the results, dissolved hydrocarbons in groundwater extents, recommendations for remediation, and a human health and ecological risk evaluation.

Swift River Grader Station
Swift River, YT

Reviewed previous investigations, prepared a work plan and conducted a drilling investigation to determine the groundwater flow direction and to provide additional delineation of hydrocarbon and salt contamination. Site assessment included soil monitoring, soil and groundwater sampling. Report included an assessment of the groundwater flow regime, aquifer properties, the extent of contaminant plumes in groundwater, and recommendations for the next phase of work.

Mount Nansen Mine
Carmacks, YT

Served as Project Manager for a project to conduct monitoring and water sampling of all on-site monitoring wells, the downloading of dataloggers, and conducting groundwater response tests at each location. A data report was prepared which included an updated site map of the well locations, a summary of work completed, water level data, tables of analytical data, and analysis of groundwater response tests. The report also included recommendations for conducting future sampling events.

Canadian White Pine Sawmill
Vancouver, BC

Served as project leader for a detailed soil and groundwater investigation and remediation planning at a large former sawmill and wood treatment facility along the Fraser River. Directed three field crews during the three month field program; conducted drilling investigations over water from a barge, and conducted discrete groundwater sampling using the Waterloo Profiler in an area of deep creosote contamination. Compiled previous data and completed a detailed site investigation and remedial plan report. Provided management of the on-site remediation through soil excavation.

PROJECT EXPERIENCE – CONTAMINATED LAND REMEDIATION

Whitehorse Upper Tank Farm
Whitehorse, YT

Project Manager/Hydrogeologist for the overall project. Prepared responses to questions arising during the YESAA process, provided design of the Land Treatment Facility, updated the Plan of Restoration for the site, authored and submitted annual reporting as required by the permits and Ministerial Authorization, and provided technical support during soil excavations (which extended to 25 mbgs), groundwater sampling, and drilling. Authored a report in support of the request for a Certificate of Compliance for a portion of the site.

Korbo Apartments
Dawson City, YT

Project Manager of a large remediation project of contaminated soil. Involved the writing of tender documents for the excavation contractor, obtaining permits for the transport and treatment of contaminated soil in a land treatment facility and groundwater treatment and disposal approval. Provided technical advice to the on-site staff, reviewed and approved contractor invoices for the client, and provided review of the final report.

Fort Nelson Airport
Fort Nelson, BC

Served as Remediation Specialist during an extensive excavation of hydrocarbon contaminated soils. The excavation was conducted along utility corridors and involved the supervision of the excavation during the support, removal and reinstatement of storm, sanitary, gas, and water lines by the excavation contractor. The site was a former US and Canadian military base during the construction of the Alcan Highway. Sites were remediated and reporting completed with the goal to obtain BC Certificates of Compliance at each of the 51 remediation sites within the airport property.

Education

PhD in Hydrogeology / Geochemistry, Earth Sciences, University of Waterloo, 2016

MSc in Hydrogeology / Geochemistry, Earth Sciences, University of Waterloo, 2010

BSc with Specialization Environmental Earth Science with Distinction, University of Alberta, 2006

Golder Associates Ltd. – Whitehorse

Emily is a junior hydrogeologist and geochemist involved in environmental site assessments, remediation and water supply projects. MSc and PhD work has focused on using geochemistry and isotope geochemistry in hydrogeologic applications. She has applied a wide variety of traditional and novel isotopic tracers to regional groundwater systems in Ontario (Oak Ridges Moraine) and Greenland (Kangerlussuaq). The work in Kangerlussuaq, Greenland included groundwater studies in fractured crystalline rock and continuous permafrost, surface water studies and pore water and fracture mineral characterization. Through research Emily has developed extensive field experience in surface and groundwater monitoring, technical report writing, and familiarity with geochemical modeling (PHREEQC and NETPATH).

Employment History

Golder Associates Ltd. – Whitehorse, YT

Geochemist / Hydrogeologist (2016-present), Geoscientist in Training (GIT)

Involved with a contaminated sites projects in the Yukon and Alaska. Experience in planning and carrying out field work in northern Canada. Has authored or assisted with chapters or reports for environmental assessments, baseline water quality reports and government regulatory documents.

Earth Observation Systems Laboratory, University of Alberta

Research Assistant (2005)

Analysed and processed satellite imagery.

Hydrogeology Laboratory – University of Alberta

Research Assistant (2006)

Fieldwork at the Syncrude oilsands site and at a protected wetland in Alberta including: slug tests, water level measurements, geophysics, soil moisture content, water sampling. Lab work included data processing and developing use of satellite imagery in the lab.

Nuclear Waste Management Organization, Toronto, ON

NSERC Industrial Partnership (2009 - 2012)

As part of the NSERC Industrial scholarship, 50 days per year must be sent working with the partnering company. Work included attending the annual NWMO Geoscience Seminar to present progress of the Greenland Analogue Project (GAP), writing and editing the geochemistry section of the annual GAP report, field work in Greenland and communication with NWMO and other GAP funding parties.

PROJECT EXPERIENCE – SITE ASSESSMENT AND REMEDIATION

Centre of Hope Remediation
Whitehorse, YT
May 2016 - present

Assisted with conducting groundwater and soil vapour sampling to provide data for a risk assessment. Tabulated and screened all historical data to applicable Yukon standards for risk assessment.

Palace Grand Theatre
Dawson City, YT
June 2016

Assisted with report writing for environmental assessment.

Drury Creek Maintenance Yard
Robert Campbell HWY, YT
Jun 2016 - Oct 2016

Completed historical document review and updated field work plan. Wrote report on existing septic and drinking water systems and made recommendations for potential new drinking water well locations.

Skagway Ore Terminal Basin
Skagway, AK
Aug 2016 - present

Reviewed and summarized existing reports on metals and hydrocarbon contamination in the Skagway harbour sediments. Tabulated historical marine sediment chemistry. Assisted with developing a sampling and analysis plan for a sediment and benthic sampling program in support of a Remedial Investigation Feasibility Study.

Whitehorse Airport ESA
Whitehorse, YT
Nov 2016 - present

Created site conceptual model. Drilling and installation of 31 monitoring wells, groundwater sampling of new and existing monitoring wells. Wrote the environmental site assessment report and assisted with proposed plan for remediation.

K19 – Alaska Highway
Truch Township
Feb 2017 - Mar 2017

Compilation and screening of large soil and groundwater dataset. Updated soil and groundwater standards for a wide variety of contaminants to the BC CSR Stage 10 standards.

Dease Lake Phase I ESA
Dease Lake, BC
March 2016

Desktop study of site located along Dease Lake in northern B.C. and writing of Phase I ESA report.

PROJECT EXPERIENCE – ENVIRONMENTAL MONITORING

Yukon Landfill Monitoring
Yukon Territory
May 2016 - present

Sampling of groundwater monitoring wells and surface water receptors at seven landfill sites throughout the territory. Drilling and installation of new monitoring wells at three landfill sites. Assisted with data analysis and report writing.

WPYR Shops and Wharf
Skagway, AK
May 2016 - present

Sampling of groundwater monitoring well network for the Whitepass and Yukon Route railway. Wrote annual report summarizing findings of ongoing groundwater monitoring at the maintenance shops site.

Whitehorse WMF
Whitehorse, YT
May 2016 - present

Sampling of groundwater monitoring well network, surface water receptors and surface water flow measurements. Assisted with data analysis and report writing.

Diavik Diamond Mine Depressurization Plan
Northwest Territories
Dec 2016

Monitoring a long term pumping test to determine hydraulic conductivity in an enhanced permeability zone.

PROJECT EXPERIENCE – REGULATORY AND BASELINE

Yukon Groundwater Monitoring Guidance Document
Yukon Territory
Sept 2016 - present

Completed an interjurisdictional review of guidance documents and standards for groundwater monitoring, well installation and sampling at contaminated sites.

Eagle Plains Baseline Water Quality Study
Whitehorse, YT
Nov 2016 - present

Assessed baseline groundwater quality and groundwater-surface water interaction for the Eagle Plains region of the Yukon and assisted in writing the baseline water quality report.

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers and Geoscientists of Alberta, Member in Training.

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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APPENDIX C

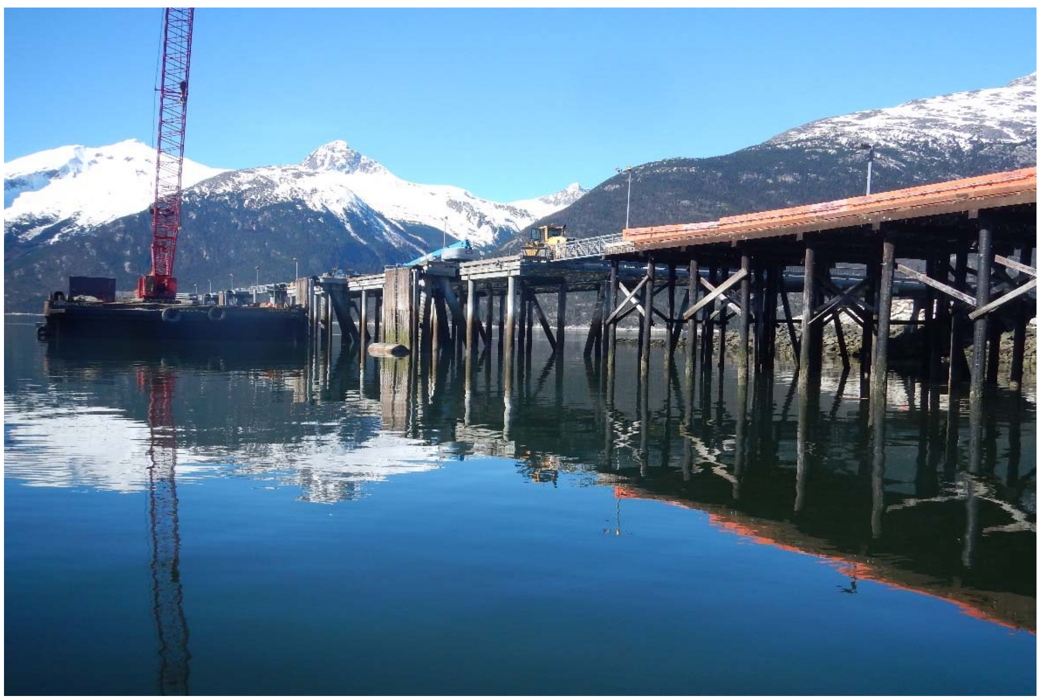
Surficial Sediment Field Data Report

10 January 2018

FIELD INVESTIGATION SUMMARY REPORT

Skagway Ore Basin Sediment Assessment - Field Investigation

Submitted to:
White Pass & Yukon Route Railway
P.O. Box 435
Skagway, AK 99840



REPORT

Report Number: 1657231-004-R-Rev0

Distribution:

1 e-copy - White Pass & Yukon Route Railway
1 e-copy - Golder Associates Ltd.

Golder Associates

Table of Contents

TABLES

FIGURES

APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

ADEC……… Alaska Department of Environmental Conservation
AIDEA ……… Alaska Industrial Development and Export Authority
ALS……… ALS Laboratory Group, Environmental Division
ASTM……… American Society for Testing and Materials
AVS………Acid Volatile Sulphide
CRM……… Certified Reference Material
CSL………Cleanup Screening Levels
DL ……… Detection Limit
DO………Dissolved Oxygen
DQO……… Data Quality Objective
DRO……… Diesel Range Organics
GPS………Global Positioning System
HaSEP………Health and Safety Environment Plan
HPAH……… High Molecular Weight PAH
LCS………Laboratory Control Standard
LPAH……… Light Molecular Weight PAH
PAH………Polycyclic Aromatic Hydrocarbons
PSEP………Puget Sound Estuary Program
QA/QC ………Quality Assurance / Quality Control
RPD ……… Relative Percent Difference
RRO……… Residual Range Organics
SAP………Sampling and Analysis Plan
SCO……… Sediment Cleanup Objective
SEM………Simultaneously Extractable Metals
TOC ………Total Organic Carbon
USEPA……… United States Environmental Protection Agency
wt………Wet Weight
WDOE……… Washington State Department of Ecology
WPYR……… White Pass & Yukon Route

LIST OF UNITS

cm ……… centimetre
m ……… metre
mg ……… milligram
% ……… percent

1.0 INTRODUCTION

1.1 Purpose of this Document

This document provides a summary of the field activities conducted by Golder between April 25 and May 5, 2017 in support of an ecological and human health risk assessment for the Skagway Ore Terminal (the “Ore Basin”). A sampling and analysis plan (Golder 2017) was approved by White Pass & Yukon Route (WPYR) and the Alaska Department of Environmental Conservation (ADEC) prior to executing the sampling program. This field data report provides a detailed description of the sampling program along with a figure showing the locations of all samples. Site photographs, field records, laboratory certificates of analysis and laboratory review checklists are included as appendices following the guidance from ADEC (2016).

The sampling program consisted of:

- Collection of surficial sediment samples for chemical analysis. An archive of each sample was retained for toxicity testing. Toxicity testing was conducted on a subset of samples that represented the gradient of metals potentially associated with operation of the ore loading facility.
- Collection of benthic community samples which were archived.
- Collection of marine invertebrates (mussels, crabs, prawns, and shrimp) to provide information about tissue concentrations of metals and hydrocarbons.

1.2 Site Description

The Skagway Ore Terminal and other portions of Skagway Harbour are shown on Figure 1. Skagway Harbour lies at the terminus of a deep fjord (Lynn Canal) on the historical alluvial fan of the Skagway River. The harbour consists of a limited near-shore zone with a typical water depth of between 30 and 40 feet (measured from mean low tide) which transitions rapidly to the deeper waters in Lynn Canal (Anchor 2015). The shoreline of Skagway Harbour was established on the historical alluvial fan through a combination of dredging and filling in the early 1900s (Tetra Tech 2008). Changes to the harbour configuration were made during the construction of the Small Boat Harbour (circa 1958), the State Ferry Terminal (circa 1963), and the expansion of the Ore Terminal (circa 1968), all of which involved dredging and use of the dredged material to expand and reconfigure the shoreline (Anchor 2015).

A brief summary of historical site activities at the Ore Terminal (Anchor 2015) as context for the sampling program:

- The Ore Terminal portion of the harbour was leased by White Pass & Yukon Route (WPYR) from the Municipality of Skagway in the late 1960s and was used for the trans-shipment of lead and zinc ore concentrate from the Faro Mine using an open conveyor system between 1967 and 1982.
- Sporadic use of the facility for shipping ore concentrates continued between 1982 and 1997 with a variety of terminal operators. The conveyor system was enclosed in 1991.
- A concrete dock was added in 2000 to allow the facility to be used by cruise ships, and the historical ore concentrate building was demolished in 2003. A new concentrate building was constructed and has been used for shipment of copper concentrates from the Minto Mine since 2007.
- The terminal is currently operated by Alaska Industrial Development and Export Authority (AIDEA). Infrastructure includes a fuel depot (operated by Petro Marine Services) and a container facility (operated by Alaska Marine Lines) in addition to the ore concentrate shipping and cruise ship docking.

2.0 METHODOLOGY

2.1 Health, Safety, and Environment Plan

Golder prepared a project-specific Health and Safety Environment Plan (HaSEP) that described the proposed stations and scope of sampling, identified the field crew, itemized key vessel safety equipment, provided emergency contact information, described the expected communication process with other vessels and the Harbour Master, and outlined the expected project-specific hazards and the required mitigation. The HaSEP was distributed to the field crew for review in advance of the sampling program and a project kickoff meeting was conducted with the field crew, project manager and project directory. A daily safety briefing was conducted where the field crew reviewed the HaSEP, the associated safe work procedures, environmental conditions such as weather, as well as emergency procedures. No issues with respect to the health and safety of the field crew occurred during the sampling program.

2.2 Sampling Overview

2.2.1 Sampling Effort

Sampling was conducted between April 25 and May 5, 2017. A total of 24 stations were sampled for chemistry and volume was archived for toxicity testing. Benthic community samples were collected from 14 of those locations. Tissue samples (one or more of crabs, shrimp or mussels) were collected from three different areas in Skagway Harbour (e.g., near-field, mid-field and far-field) as well as from reference locations. The locations of all samples collected are provided on Figures 1 through 3. Data tables are provided in Appendix A, and discussed further in subsequent sections of this report.

2.2.2 Field Observations

Photographs of the field activities are provided in Appendix B, and field datasheets are provided in Appendix C with the following information for each sampling station:

- Station name
- Date and time
- Names of sampling crew
- Weather conditions
- Station water depth
- GPS coordinates
- Type of sampling gear used, and number of successful and unsuccessful grabs taken
- Photographs of sediment samples and sampling stations
- A description of the sediment description in terms of texture, colour, organisms, (e.g., shells, worm tubes); anthropogenic debris (e.g., wood chips), sheen and odour, vertical profile and penetration depth

2.2.3 Deviations from Sampling and Analysis Plan

The proposed sampling program described by Golder (2017) was successfully completed with modifications as described below. These modifications were made after consultation with the Golder project management team and further details are provided in the field forms in Appendix C:

- Golder (2017) proposed a total of 31 sediment stations. It was not possible to collect all 31 sediment samples within the available field time because of challenges in getting adequate grab penetration in what was frequently a predominantly cobble substrate. A total of seven stations were ultimately not sampled[1], but Golder concludes that this is not a significant limitation because we were successful in getting adequate spatial coverage within the Ore Basin, with particular emphasis on the area of greatest concern based on the historical chemistry data (i.e., the gradient of metal concentrations as shown in Golder 2017).
- Benthic invertebrate community samples were only collected at 14 of the 24 targeted stations (as part of the prioritization of the available field time in light of the challenge in getting an adequate grab penetration). Sampling effort for the benthic community analysis focused on providing spatial coverage within the Ore Basin as well as reference areas.
- The desired penetration depth for the sampler was a minimum of 0.5 ft in order to collect an undisturbed sample from the upper 0.3 ft. It was ultimately necessary to retain some grab samples for chemical and toxicological analysis that achieved less than this desired penetration depth. Golder took additional action in the field to maximize grab penetration by adding extra weights to the sampling device. We opted to retain the station even if grab penetration was lower than expected. Note that grab volumes were consistent among replicates at each station. Detailed records were made in case it becomes necessary to consider this variable in the analysis.

No further deviations from the sampling and analysis plan (Golder 2017) were identified in the course of the investigation.

[1] All proposed sample locations were assigned a sample ID which was retained irrespective of whether a location was successfully sampled. SED17-02, SED17-04, SED17-16, SED17-23, SED17-25, SED17-26 and SED17-30 were not sampled, and therefore, those IDs do not contain data in this current data report.

Table 1: Sample Collection Information for Sediment Stations

Sampling Area	Station ID	Date Sampled	UTM Coordinates (8V)		Chemistry Sample	Bioassay Archive	Benthic Archive Sample
			Easting (m)	Northing (m)			
Ore Basin	SED17-07	5/4/2017	481458.93	6590209.32	Yes	Yes	No
	SED17-11	4/30/2017	481462.24	6590226.34	Yes	Yes	Yes
	SED17-12	5/4/2017	481441.46	6590230.78	Yes	Yes	No
	SED17-13	4/29/2017	481438.00	6590246.00	Yes	Yes	Yes
	SED17-06	4/26/2017	481438.17	6590150.95	Yes	Yes	Yes
	SED17-08	4/26/2017	481426.37	6590208.25	Yes	Yes	Yes
	SED17-09	4/29/2017	481428.01	6590241.77	Yes	Yes	Yes
	SED17-10	5/5/2017	481509.08	6590250.16	Yes	Yes	No
	SED17-14	4/30/2017	481487.27	6590255.17	Yes	Yes	Yes
	SED17-05	4/25/2017	481378.07	6590129.31	Yes	Yes	Yes
	SED17-17	4/30/2017	481589.04	6590274.61	Yes	Yes	Yes
	SED17-18	5/2/2017	481586.52	6590376.17	Yes	Yes	Yes
	SED17-01	5/4/2017	481441.18	6590059.17	Yes	Yes	No
	SED17-03	5/4/2017	481231.14	6590126.25	Yes	Yes	No
	SED17-15	5/5/2017	481497.44	6590155.22	Yes	Yes	No
	SED17-19	5/2/2017	481679.59	6590334.07	Yes	Yes	Yes
Outside Ore Basin	SED17-20	5/1/2017	481718.45	6589906.04	Yes	Yes	Yes
	SED17-21	5/1/2017	481622.02	6589771.76	Yes	Yes	No
	SED17-22	5/1/2017	481455.81	6589611.21	Yes	Yes	Yes
Dyea Point	SED17-24	5/2/2017	480212.59	6591424.91	Yes	Yes	Yes
Taiya River	SED17-27	5/5/2017	480213.13	6593546.11	Yes	Yes	No
	SED17-28	5/2/2017	480174.80	6593163.56	Yes	Yes	No
Nahku Bay	SED17-29	5/4/2017	480986.33	6593224.74	Yes	Yes	No
	SED17-31	4/28/2017	480779.90	6593228.80	Yes	Yes	Yes

Notes: No samples were collected from Stations SED17-02, SED17-04, SED17-16, SED17-23, SED17-25, SED17-26 and SED17-30

Table 2: Sample Collection Information for Invertebrate Tissue Stations

Sampling Area	Sample ID	Date	UTM Coordinates (8V)		Species Collected
			Easting (m)	Northing (m)	
Far-field location, within Skagway Harbor but outside Ore Basin in area underneath Railroad Dock	FF-MUSSEL-01	29-Apr-17	481663.77	6589832.03	Blue mussel (*Mytilus edulis*)
	FF-MUSSEL-02				
	FF-MUSSEL-03				
	FF-MUSSEL-04				
	FF-MUSSEL-05				
Mid-field location at outlet Skagway River	MF-CRAB-01	03-May-17	481142.21	6590178.93	Dungeness crab (*Metacarcinus magister*)
	MF-CRAB-02				
	MF-CRAB-03		481170.76	6590150.49	
	MF-CRAB-04				
	MF-CRAB-05				
Near-field location within Ore Basin underneath Ore Dock	NF-MUSSEL-01	29-Apr-17	481438.01	6590257.53	Blue mussel
	NF-MUSSEL-02				
	NF-MUSSEL-03				
	NF-MUSSEL-04				
	NF-MUSSEL-05				
Near-field location within Ore Basin	NF-CRAB-01	01-May-17	481415.59	6590112.75	Dungeness crab
	NF-CRAB-02	04-May-17	481347.94	6590102.29	
	NF-CRAB-03		481393.56	6590165.98	
	NF-PRAWN-01	03-May-17	481537.33	6590322.74	Alaskan pink shrimp (*Pandalus borealis*), Spot prawn (*Pandalus platyceros*) and Coonstripe shrimp (*Pandalus hypsinotus*)
	NF-PRAWN-02				Coonstripe shrimp
	NF-PRAWN-03	04-May-17	481429.07	6590202.11	Spot prawn
	NF-PRAWN-04				
	NF-PRAWN-05				
Reference location, rocks on beach area between Taiya River and Dyea Point	REF-MUSSEL-01	29-Apr-17	480166.71	6592497.78	Blue mussel
	REF-MUSSEL-02				
	REF-MUSSEL-03				
	REF-MUSSEL-04				
	REF-MUSSEL-05				
Reference location, within Nahku Bay	REF-CRAB-01		480903.00	6593282.63	Dungeness crab
	REF-CRAB-02				
	REF-CRAB-03	05-May-17	480962.67	6593207.27	
Reference location, within Nahku Bay	REF-PRAWN-01	04-May-17	480872.42	6593296.15	Spot prawn
Reference location by Dyea Point	REF-PRAWN-02	05-May-17	480217.59	6591449.05	Alaskan pink and coonstripe shrimp
Reference location, within Nahku Bay	REF-PRAWN-03		480874.65	6593299.81	Spot prawn

2.3 Sample Collection Methods

All samples were collected in accordance with the specific methods described by Golder (2017) which were consistent with ADEC (2016) and other relevant standard reference material (e.g., ASTM 2014, WDOE 2015). Specific methods are described below, but overall:

- All sampling was conducted by trained, experienced personnel (i.e. a Qualified Environmental Professional) following a specific work instruction approved by the Golder project manager.
- Field records were maintained (for every station) to record field observations, time of sampling activities, deviations, records of observations and discussions, safety briefings, etc.
- All samples were placed in laboratory-supplied containers, preserved as directed by the analytical laboratories, and maintained at the appropriate temperature.

Note that measurements made in the field are presented in both metric and Imperial units, while measurements made by the analytical laboratories are generally presented as metric units only. Metric units are generally used in the technical guidance.

2.3.1 Surface Sediment Collection (Chemistry and Toxicology)

Surface sediment samples were collected using a Van Veen (1.0 ft^2 surface area) grab sampler to obtain sediment from each station. It was necessary to deploy the grab numerous times to collect sufficient sediment volume for the chemistry/toxicity analyses. The number of grabs needed to achieve the necessary sediment volume varied depending on penetration depth. Grab replicates were collected within a few feet of each other at each station (based on GPS coordinates). Each grab that was retrieved was examined to determine its acceptability, based on the following criteria (unacceptable grabs were discarded):

- The sampler was fully closed and was not held open with large rocks or other debris.
- The sample was not overfilled or disturbed, and sampler was not deployed on an angle (sediment surface does not touch the top of the sampler, and is relatively flat).
- The sampler was not leaking (there was overlying water present and no visible leaks).

If the grab was classified as acceptable, overlying water in the grab was removed using a siphon and the sediment was spooned into a stainless steel bowl. A description of the sediment with respect to colour, particle size, odour, and presence of non-sediment materials (e.g., shells, debris, and biota) was recorded. Any obvious debris (e.g., trash) and large rocks were removed and discarded. Equal volumes from each acceptable grab were composited by gently mixing the composite until consistent in texture and colour. Aliquots of this composite sample were transferred to laboratory-supplied, labelled containers. Sample containers were filled to minimize headspace. Samples were kept cold and dark until arrival at the respective analytical laboratory (ALS Environmental, Kelso, WA; Nautilus Environmental, Burnaby BC). Archive samples for chemistry and benthic community analysis were transported via truck to Golder Associates (Whitehorse, YT) and refrigerated where necessary. In total, the following sample containers were filled:

- 1- 8oz jar for grain size and total organic carbon
- 1- 4oz jar for metals, PAH & DRO/RRO
- 1- 4oz jar for AVS-SEM
- 1- 4oz jar for chemistry archive
- 1- 4L (140 oz) high-density polyethylene pail for toxicity testing

All sampling and homogenization equipment (the Van Veen sampler, bowls and spoons) were decontaminated prior to use at each sampling station and upon completion of each day's sampling. Decontamination entailed washing with a scrub-brush and laboratory-grade detergent (Liquinox®) followed by rinsing with site water. Spoons and bowls were also kept covered during sampling and between sampling stations to prevent cross-contamination via dust deposition.

2.3.2 Benthic Community Sample Collection

Samples were collected for the assessment of benthic infaunal community structure at 14 stations (Table 1). Samples collected for benthic community analysis used the same criteria for assessing a successful sample as grabs collected for chemistry and toxicological analysis. No compositing was involved; on collection, the total contents of a single, acceptable Van Veen grab from each station were sieved through a 1-mm mesh screen in the field. All material (benthic organisms and debris) retained on the screen were transferred to a storage container and preserved in buffered formalin to a final concentration of 5-10%. All benthic samples were transported to the Golder Whitehorse office for archiving.

2.3.3 Tissue Sample Collection

All tissue sampling was authorized under a permit issued by Alaska Department of Fish and Game (FRP CF-17-073).

2.3.3.1 Blue Mussel (Mytilus edulis) Collection

Five separate samples were collected from near-field, far-field and reference areas (see Figure 3 for locations). Each sample was comprised of 30 or more grams (i.e., approximately 1 – 2 oz) of tissue which amounted to 10 to 15 individuals per replicate. Each mussel was selected from the same height (below the high tide mark) from intertidal substrates and was between 4 and 8 cm in size (e.g., approximately 2 – 3 inch). The mussels were collected whole and stored on ice until they could be processed indoors away from the Ore Terminal (to reduce the possibility of cross-contamination from dust deposition). Mussels were shucked and the soft tissues rinsed with deionized water to remove shell pieces and other debris. Tissue samples were handled with clean stainless steel instruments (i.e., scalpels and forceps), weighed and aliquoted into foil-lined labeled whirl packs which were then stored in a freezer. The samples were transported on ice (frozen) to ALS Environmental for analysis. All equipment that came in contact with samples were decontaminated with Liquinox® and deionized water between sample stations.

2.3.3.2 Dungeness Crab (Metacarcinus magister) Collection

Baited crab traps were deployed on incoming tides (where practical) or deployed in the late afternoon or evening hours for retrieval the following morning. The traps were allowed to soak for at least eight hours. The target was collect between three and five mature crabs per area. If an adequate number of crabs were not collected in the first deployment, the traps were redeployed in the same area for a second round. Traps were checked every eight to 16 hours until a sufficient number of crab were collected from a sampling area. Crabs were only retained if they were of legal size and gender. Total carapace length, weight and external abnormalities (e.g., deformities, erosions, lesions, tumors, fungus, and parasites) were noted on the processing form (Appendix C). Crabs were sacrificed onboard the vessel (by pithing) but were not processed further. The sacrificed crabs were stored on ice until they could be frozen later the same day. The crabs were shipped to ALS for removal of edible muscle tissue for the chemical analysis.

2.3.3.3 Shrimp/Prawn Collection

Baited prawn traps were co-deployed with the crab traps. A variety of species were captured (Alaskan pink shrimp, Spot prawn and Coonstripe shrimp) in the traps. Collected organisms were stored on ice until they could be processed indoors (see description of methods for mussel processing). The length from uropod to rostrum, species and weight were noted in the field notes. Each tissue sample consisted of one or more individuals composited as needed to achieve 30 g (i.e., 1 – 2 oz) of tissue. Tissue samples were handled with clean stainless steel instruments (i.e., scalpels and forceps), weighed and aliquoted into foil-lined labeled whirl packs which were then stored in a freezer. The samples were transported on ice (frozen) to ALS Environmental for analysis. All equipment that came in contact with samples were decontaminated with Liquinox® and deionized water between sample stations.

2.3.4 Field Quality Assurance/Quality Control

All samples were collected by experienced individuals and care was taken to minimize the introduction of foreign material into the samples or loss of the material of interest from the samples prior to analysis. Field notes and field forms were maintained to document the field sampling program. Chain-of-custody forms were updated as samples were collected, and were checked to verify the information recorded before samples were submitted. Additional field QA/QC activities sample collection included the following:

- All sampling bowls and spoons were cleaned with a laboratory-grade detergent and rinsed with deionized and site water prior to use at each station.
- Field duplicates were collected for 3 of the 24 sediment samples. Sediment field duplicates were taken as split samples from the same grab.
- A travel, field and equipment blank were submitted for analysis to confirm that sampling and transport methods have not introduced additional contamination of the substances of interest.
- Samples were carefully packaged to prevent breakage and shipped with ample ice to maintain the samples at the appropriate temperature. A temperature blank was included during shipment to ALS to confirm that samples were maintained at temperatures throughout the multiple stage transport process (two flights plus

courier). Samples for toxicity testing were shipped direct from Whitehorse to Vancouver and therefore, a temperature blank was not considered necessary.

- The relative percent difference (RPD) was calculated to assess variability between field duplicates as follows:

$$RPD = \left(\frac{sample - duplicate}{(sample + duplicate)/2}\right) \times 100$$

2.4 Analytical Parameters and Methods

2.4.1 Sediment Chemistry and Physical Parameters

Details of the specific analytical methods for sediment chemistry are described in the certificates of analysis in Appendix D. In brief, the analytical methods included:

- All sediment samples were analyzed for metals, polycyclic aromatic hydrocarbons (PAHs), grain size, and total organic carbon (TOC). These data were necessary to select a subset of samples for additional chemical analysis or toxicity tests.
- The majority of samples were analyzed for Diesel Range Organics (DRO) and Residual Range Organics (RRO). A small number of samples (i.e., three) were not submitted for this analysis because they had PAH concentrations that were similar to other samples from the same area that were already selected for analysis.
- The majority of sediment samples were also submitted for analysis of simultaneously extractable metals (SEM) and acid-volatile sulphides (AVS). Samples were selected for AVS-SEM analysis based on consideration of the lead, zinc and copper concentrations and to focus on those samples selected for toxicity testing. A small number of samples (i.e., seven) were not submitted for this analysis.

2.4.2 Tissue Chemistry in Aquatic Biota

Details of the specific analytical methods for tissue chemistry are described in the certificates of analysis in Appendix D. All tissue samples were analyzed for total metals, PAHs and percent moisture. Homogenates were retained (frozen) for additional analysis as needed. A subset of the samples were selected for metal speciation analysis (e.g., hexavalent Cr, organic As).

2.4.3 Selection of Samples for Toxicity Testing

A subset of 14 of the 24 sediment samples were submitted to Nautilus Environmental (Burnaby, BC) for toxicity testing. Nautilus is accredited by the Washington State Department of Ecology for specific toxicological tests. Samples for toxicity testing were selected based on a review of the sediment chemistry to capture the gradient of metals concentrations in the samples collected, and to provide spatial coverage of the different zones of interest. The fourteen samples were allocated as follows:

- Ten samples from within the ore basin were selected for analysis, including the worst-case and second worst-case concentrations for both metals and PAHs (i.e., from within Zone A). The remainder of the samples within the ore basin were selected to provide spatial coverage in the three other zones.
- One of the three samples collected from outside the ore basin was selected for testing. There were no substantive differences in sediment chemistry amongst these three samples that warranted selection of additional samples.
- Three of the five samples collected from reference areas were selected for testing. The three samples were selected to have a similar grain size and organic carbon content as the range of samples collected from within the ore basin.

The tests in the current assessment were described in Golder (2017) and included:

- 96-h echinoderm (*Strongylocentrus purpuratus*) larval development
- 10-d amphipod (*Eohaustorius estuaries*) survival and
- 20-d polychaete (*Neanthes arenaceodentata*) survival and growth

All three tests are routinely used for sediment characterization and dredged material disposal purposes. There is extensive toxicological literature available with respect to the sensitivity of these test organisms to the specific contaminants of interest, along with information on sensitivity to other factors such as grain size, ammonia, and sulphides. A brief overview of each toxicity testing method is provided below.

2.4.4 Echinoderm Larval Development Test

The 96-h echinoderm larval development toxicity test followed the PSEP (1995) protocols with some modifications. The day before test initiation, each sediment samples was composited and 18 g weighed out into 5 replicates. Each container was then filled with 900 mL of natural seawater and stirred to ensure sediment resuspension. The controls consisted of just 900 mL seawater. These test vessels were then left overnight in the testing room at 15±1°C. PSEP 1995 protocols state that a 4 hour settling time is required prior to the addition of organisms to the test container. For this set of tests the sediment was allowed to settle for 24 hours to ensure that the physical effects of suspended sediments have a minimal effect on the echinoderm eggs. Organisms were scheduled to arrive at the laboratory on the day of test initiation. Spawning of the echinoderms (sea urchins; Strongylocentrotus purpuratus) were induced by injection of 0.5M KCl. Once sufficient gametes were collected, the eggs were fertilized and development monitored. The test containers were seeded at a density of ~25 eggs/mL within 2 hours of fertilization. Water quality measurements were monitored throughout the test (temperature, pH, DO, salinity), and ammonia and sulphides measured at test initiation and termination. A concurrent reference toxicant test using copper was conducted. Each test was terminated around 96-h (dependent on development). The overlying water was decanted and a 10 mL aliquot from each container transferred to a glass vial and preserved with buffered formalin. These vials were enumerated for normality/abnormality, the final endpoints of survival, proportion normal, and combined proportion normal were then reported.

2.4.5 Amphipod Test

This static, acute toxicity test is used to determine the relative toxicity of estuarine and marine sediments using the haustoriid amphipod *Eohaustorius estuarius*. Immature adult amphipods are exposed to test sediments in a static system for 10 days. Test containers are 1-L glass jars containing a 2-cm layer (175 mL) of sediment and 800 mL of clean seawater, adjusted to the appropriate salinity. There are five replicates per treatment, plus an additional replicate for monitoring water quality, each with 20 amphipods. The sediments and seawater (salinity adjusted if necessary) are prepared one day, and allowed to settle overnight. The next day (Day 0), amphipods are counted out and added to the sediments (unless purging is required due to high ammonia concentrations). Water quality and emergence (avoidance) from sediment are recorded daily. On Day 10, water quality is recorded for every replicate, counts are made of live and dead amphipods, and the ability of surviving amphipods to rebury in clean sediment is assessed. The response of amphipods exposed to test sediments is compared with the response of amphipods exposed to control sediment (or appropriate reference sediment). Survival is the primary endpoint; emergence and reburial are secondary endpoints that can indicate aversion to sediment by amphipods.

2.4.6 Polychaete Test

This test uses the juvenile life stage of the polychaete *Neanthes arenaceodentata* to determine the relative toxicity of marine sediments by evaluating both lethal and sublethal effects in a 20-day static-renewal exposure system. The test container is a 1-L glass jar containing a 2-cm layer (175 mL) of sediment and 800 mL of clean seawater (28 ppt salinity). There are six replicates per treatment (five for toxicity, plus one for monitoring water quality), each containing five worms. The sediments and seawater are prepared one day prior to test initiation (Day -1) and allowed to equilibrate overnight. The following day (Day 0), the worms are sorted, counted and distributed to the test containers. Additional subsamples of worms are also dried overnight to determine average initial dry weights. Partial renewal of the overlying water is performed every three days, and organisms are fed every two days. Test conditions are monitored during the 20-d exposure period. On Day 20, worms are sieved from the sediments to determine mean survival. Surviving worms are transferred to pre-weighed foil pans, dried overnight and weighed to determine total dry weight, average individual dry weight, and average individual growth rate. The response of worms exposed to test sediments is compared with the response of worms exposed to control sediment (or appropriate reference sediment) for each endpoint (survival, total dry weight, average individual dry weight, average individual growth rate).

2.4.7 Laboratory Quality Assurance/ Quality Control

Details regarding the laboratory QA/QC activities for the sediment and tissue chemistry are described in Appendix D. The laboratory analyses included laboratory control samples (LCS), matrix replicates, matrix spikes (MS), surrogate spikes for organic analyses, method blanks, standard reference materials and instrument calibrations. The certificates of analysis were reviewed by Golder following the ADEC-mandated laboratory data review checklists to confirm that the laboratory data quality objectives (DQOs) were met and that the appropriate QA/QC information had been reported.

Details regarding the laboratory QA/QC activities for the toxicity samples are described in Appendix E. The toxicity tests included analysis of negative controls (i.e., clean laboratory sediment or dilution water), positive controls (reference toxicant tests), and monitoring of water quality parameters (temperature, dissolved oxygen, pH and salinity) during testing to verify that the test organisms were not subjected to stress unrelated to the test material.

3.0 RESULTS

3.1 Sediment Chemistry

Copies of the ALS laboratory reports for the sediment chemistry analyses performed on the samples are provided in Appendix D, and a sediment chemistry data table is provided in Table A-1. These data were screened against the numerical standards (sediment cleanup objective, SCO; cleanup screening levels, CSL[2]) as described by WDOE (2015). It was necessary to make the following calculations as part of the data presentation:

- The percentage of fine-grained material, which is used for interpretation of sediment chemistry and toxicity results, was calculated as the sum of the silt and clay particle size fractions.
- For parameters requiring calculation of total concentrations (e.g., total PAHs) the limit of detection was used for values below the method detection limit.
- AVS and SEM were analyzed on a subset of stations to provide a chemical means to assess the potential bioavailability of selected metals such as lead, copper and zinc (DiToro et al. 1990; Ankley et al. 1991; Casas and Crecelius 1994; Chapman 1996). Detected concentrations of individual SEMs were summed to provide a "sum of SEM (ΣSEM)" concentration for each sample. Data were presented as molar differences (AVS-∑SEM) since this calculation provides a better indication of the magnitude of excess AVS than when presented as ratios (AVS/∑SEM; Hansen et al. 2009).

A brief summary of the results is provided below. Data will be evaluated in greater detail as part of the risk assessment.

3.1.1 Particle Size and Total Organic Carbon (TOC)

There was a relatively wide range of particle size distributions amongst stations in the same area. Percent fines ranged from 11 to 86% among the ore basin stations, from 65 to 72% among the stations elsewhere in Skagway Harbour, and from 35 to 89% among the reference stations. The total organic carbon (TOC) concentrations ranged from <0.23 to 1.1% among the ore basin stations, from 0.8 to 1.4% among the stations elsewhere in Skagway Harbour, and from <0.25 to 2.41% among the reference stations.

3.1.2 Metals

The concentrations of metals are provided in Table A-1. Observations based on this table include:

- Concentrations of lead in sediment collected in the Ore Basin ranged from 8.43 to 666 mg/kg, and only four of the 16 samples collected in this area exceeded the SCO. None of the sediment samples collected outside of the Ore Basin contained concentrations of lead greater than the SCO or CSL.

[2] The SCO represents the long-term sediment quality goal, while the CSL is the maximum chemical concentration or extent of biological effects allowed as a sediment cleanup level. They are used in conjunction for sediment risk management and remedial planning. The final sediment clean up level (i.e., the basis of design of remediation) is initially set at the more conservative SCO but can be adjusted upwards towards the CSL based on technical feasibility and predicted net adverse environmental impacts as part of the selection of the remedial option.

- Concentrations of mercury in sediment collected in the Ore Basin ranged from <0.021 to 0.821 mg/kg and only 2 out of the 16 samples collected in this area exceeded the SCO. One of those samples also exceeded the CSL.
- Concentrations of zinc in sediment collected in the Ore Basin ranged from 40.9 to 1040 mg/kg and only 2 out of the 16 samples collected in this area exceeded the SCO. One of those samples also exceeded the CSL.
- Concentrations of copper in sediment collected in the Ore Basin ranged from 10.1 to 207 mg/kg but none of the collected samples exceeded the SCO or CSL.

Overall, there appears to a pattern that elevated concentrations of lead, mercury and zinc are limited to the ore basin—there were no exceedances with respect to the standards for the reference samples or in samples collected outside of the Ore Basin. However, the frequency and magnitude of these exceedances was lower than expected. The maximum concentrations of metals in the collected Zone A samples were lower than those observed in the historical data from the same area, which may indicate ongoing deposition of cleaner sediment from the Skagway River.

3.1.3 Acid Volatile Sulphide (AVS) and Simultaneously Extractable Metals (SEM)

The concentrations of AVS ranged from <0.037 to 8.39 µmol/g among the Skagway Harbour stations and from 0.057 to 2.7 µmol/g among the reference stations. The ∑SEM concentrations ranged from 0.19 to 3.1 µmol/g among the Skagway Harbour stations and from 0.094 to 0.56 µmol/g among the reference stations. Overall, the molar differences (AVS-∑SEM) were negative in 8 of the 13 of the Skagway Harbour stations (i.e., there was more extractable metals present than AVS, which may indicate that some or all of the bulk metal concentration could be available for uptake by aquatic organisms. This information will be evaluated in greater detail in the risk assessment.

3.1.4 Polycyclic Aromatic Hydrocarbons (PAHs) and Extractable Hydrocarbons

The concentrations of hydrocarbons are provided in Table A-1. Observations based on this table include:

- At least one individual PAH was detected in most sediment samples, with the exception of reference stations SED17-24, SED17-27 and SED17-28 which had no detectable PAHs.
- There was a minor exceedance of the SCO with respect to the total concentration of low molecular weight PAHs in one sample, but no samples exceeded with respect to the CSL. Two samples exceeded the CSL for high molecular weight PAHs. The two samples that had exceedances of the SCO or CSL with respect to these composite PAHs measurements also had exceedances with respect to individual PAHs.

3.1.5 Quality Assurance / Quality Control

3.1.5.1 Field Duplicates

The relative percent differences for the field duplicates are provided in Appendix F. A specific limit for RPDs is not specified by ADEC (2016), but in general, an RPD of greater than 30% can indicate instances where sample homogenization may have been insufficient. This is not a pass/fail criterion because high RPDs can be generated by “nugget effects” (i.e., the presence of coal particles or metallic debris) that can impact RPDs despite all reasonable effort for appropriate sample homogenization. RPDs are also only calculated when both the original and field duplicate concentrations are greater than five times the detection because analytical uncertainty increases near the method detection limit and does not necessarily provide a good measure of variability associated with the collection of field samples. A total of three field duplicates were collected for the sediment sampling program. Golder concluded that the field duplicate RPDs were acceptable and that there was no impact on sediment quality. RPDs were less than 30% for the main metals of interest in all three duplicate pairs. The specific results of the field duplicates and a discussion with respect to data quality are as follows:

- SED17-12 and DUP-3 had RPDs ranging from 0 to 196%. The majority of the RPDs that exceeded 30% were associated with individual PAHs. Four metals (As, Cr, Fe and Ni) also had RPDs greater than 30%. Golder reviewed the field notes for this sample and confirmed that appropriate sample homogenization was conducted. Golder concluded that the high RPDs with respect to PAHs were relevant for site characterization—the original sample had no exceedances with respect to PAHs, but the field duplicate does contain concentrations that exceed the SCO. Golder will use the PAH concentrations from the duplicate to provide a conservative evaluation of this sample. The RPDs for the four metals were not a data quality issue since both the original and field duplicate concentrations were substantially lower than the SCO. The pattern of a high RPD for Fe and Ni suggests that a piece of metallic debris is influencing these RPDs.
- SED17-18 and DUP-2 had RPDs ranging from 0 to 67%. Five RPDs exceeded the 30% trigger. Four were related to individual PAHs, but there was no issues with respect to data quality because all four PAHs had concentrations that were substantially lower than the SCO in both the original and field duplicate samples. The fifth RPD greater than 30% was related to Cr, but the concentrations in both the original and field duplicate samples were also substantially lower than the SCO.
- SED17-31 and DUP-1 and RPDs ranged between 0 and 60%. Only one substances had an RPD greater than 30%, and the concentrations of that individual PAHs in both the original and field duplicate samples were substantially lower than the SCO. 1 of 41 analyzed compounds had an RPD greater than 30%.

3.1.5.2 Blank Samples

Trip, field and equipment blank samples were included in the program and analyzed for total metals to be compliant with ADEC (2016) guidance. The purpose of these blanks is to trace potential sources of artificially introduced contamination (i.e., contamination that does not originate from media of interest that is being analyzed). The presence of artificial sources of contamination, if substantive, would be a source of bias that could change how the data were interpreted (i.e., a sample might be deemed to be exceeding numerical standards when in fact it does not). Golder concluded that the blank samples demonstrated that artificial sources of contamination were not biasing the available data based on:

- The trip blank (i.e., a deionized water sample provided by the laboratory that travelled to and from the site without being opened) had no detectable concentrations of total metals with the exception of manganese (which had a quantifiable concentration that was marginally greater than the reportable detection limit).
- The field blank (i.e., a deionized water sample provided by the laboratory, opened in the field, and poured into a sampling container) had no detectable concentrations except for calcium, magnesium and manganese. All three substances were quantified at a concentration that was less than 5x the reportable detection limits).
- The equipment blank (i.e., a deionized water sample that was opened in the field and poured through the sampling equipment after decontamination was completed) also had detected concentrations of aluminum, calcium, iron, magnesium, magnesium and sodium. Sodium and magnesium was greater than 5x the reportable detection limits. Golder reviewed the data quality in light of this equipment blank and concluded that these metals and metalloids were unsurprising, given that deionized water was being rinsed over equipment that had been decontaminated and then rinsed with seawater (i.e., any residual seawater would contribute the ions detected). Both copper and lead were also detected in the equipment blank, but at extremely low total concentrations.

Golder concludes that the available blank data demonstrated that cross-contamination or the introduction of artificial sources of contamination that could bias the outcome of the data was not present. The minor detected concentrations of copper and lead in the equipment blank are not considered to be a bias in the sediment chemistry data—any particulate of sediment or dust that was ultimately caught in the equipment blank would result in a detected total concentration.

3.1.5.3 Data Quality Checklists

The analytical laboratory provided a case narrative for each certificate of analysis which discussed the internal laboratory control measures. There were no deviations described in the case narratives which were considered by the analytical laboratory to impact overall data quality. The ADEC laboratory review checklist was completed by Golder and is provided in Appendix G. Overall, Golder concludes that the sediment data are reliable and suitable for the risk assessment based on consideration of both the laboratory and field QA/QC components.

3.2 Sediment Toxicity

3.2.1 Summary of Data

The analytical data appendices from the analytical laboratory are provided in Appendix E. A brief summary of the results is provided below in Tables 4 thorough 6. Data will be evaluated in greater detail as part of the risk assessment.

Table 3: Results of 96-h Echinoderm (Strongylocentrotus purpuratus) Larval Development Test

Sample ID	Survival ± SD (%)	Proportion Normal ± SD (%)	Combined Proportion Normal ± SD (%)
Control Sediment	86.5 ± 4.4	82.8 ± 1.5	71.6 ± 3.7
SED17-08	65.4 ± 5.3 *	0.8 ± 0.7 *(a)(b)(c)	0.5 ± 0.4 *(a)(b)(c)
SED17-06	77.6 ± 3.9	79.5 ± 2.3 (c)	61.8 ± 4.3 *
SED17-09	7.3 ± 6.6 *(a)(c)	42.6 ± 39.2 *(a)(c)	2.6 ± 3.2 *(a)(c)
SED17-13	1.7 ± 0.7 *(a)(b)(c)	3.3 ± 7.5 *(a)(b)(c)	0.1 ± 0.2 *(a)(b)(c)
SED17-17	75.3 ± 10.1	83.7 ± 6.2	63.8 ± 7.8
SED17-20	2.4 ± 1.0 *(a)(b)(c)	13.3 ± 29.8 *(a)(c)	0.4 ± 1.0 *(a)(b)(c)
SED17-18	31.0 ± 17.4 *(a)(c)	70.6 ± 16.9 (c)	23.3 ± 16.2 *(a)(c)
SED17-19	14.1 ± 9.9 *(a)(c)	25.8 ± 29.5 * (a)(c)	5.8 ± 8.6 *(a)(c)
SED17-24	81.8 ± 9.9	83.5 ± 2.7	68.3 ± 8.5
SED17-12	56.6 ± 10.5 *(a)	0.1 ± 0.3 *(a)(b)(c)	0.1 ± 0.2 *(a)(b)(c)
SED17-01	84.4 ± 3.5	83.4 ± 6.0	70.6 ± 7.4
SED17-03	24.4 ± 9.1 *(a)(c)	80.6 ± 3.1 (c)	19.6 ± 7.5 *(a)(c)
SED17-29	20.5 ± 18.6 *(a)(c)	67.4 ± 16.8	15.9 ± 17.7 *(a)(c)
SED17-27	74.9 ± 4.2 *	87.9 ± 2.0	65.8 ± 3.9

1. SD = standard deviation; asterisks (*) indicate samples with mean survival significant lower (*p* <0.05) than their respective control.
   (a) indicates samples with mean survival significant lower (*p* <0.05) than reference sample SED17-24
   (b) indicates samples with mean survival significant lower (*p* <0.05) than reference sample SED17-29
   (c) indicates samples with mean survival significant lower (*p* <0.05) than reference sample SED17-27

Table 4: Results of 10-d Amphipod (Eohaustorius estuarius) Toxicity Tests

Sample ID	Survival (%) (Mean ± SD) [1]	Reburial (%)
Control Sediment	97.0 ± 4.5	100
SED17-08	94.0 ± 2.2	100
SED17-06	94.0 ± 4.2	100
SED17-09	35.0 ± 7.9* (a)(b)(c)	100
SED17-13	40.0 ± 12.8* (a)(b)(c)	100
SED17-17	92.0 ± 7.6	100
SED17-20	62.0 ± 15.6* (a)	98
SED17-18	91.0 ± 4.2	100
SED17-19	57.0 ± 6.7* (a)(c)	100
SED17-24	89.0 ± 11.4	100
SED17-12	83.0 ± 11.5*	100
SED17-01	77.0 ± 7.6*	90
SED17-03	96.0 ± 4.2	100
SED17-29	67.0 ± 15.2* (a)	100
SED17-27	78.0 ± 13.5*	87

1. SD = standard deviation; asterisks (*) indicate samples with mean survival significant lower (*p* <0.05) than their respective control.
   (a) indicates samples with mean survival significant lower (*p* <0.05) than reference sample SED17-24
   (b) indicates samples with mean survival significant lower (*p* <0.05) than reference sample SED17-29
   (c) indicates samples with mean survival significant lower (*p* <0.05) than reference sample SED17-27

Table 5: Results of 20-d Polychaete (Neanthes arenaceodentata) Toxicity Tests

Sample ID	Survival (%) (Mean ± SD)	Total Dry Weight (mg) (Mean ± SD)[1]	Individual Dry Weight (mg/worm) (Mean ± SD)[1]	Individual Growth Rate (mg/worm/day) (Mean ± SD)[1]
Control Sediment	96.0 ± 8.9	47.0 ± 4.9	9.8 ± 0.9	0.47 ± 0.04
SED17-08	100.0 ± 0.0	44.0 ± 9.1	8.8 ± 1.8	0.41 ± 0.09
SED17-06	96.0 ± 8.9	48.0 ± 5.5	10.1 ± 1.6	0.48 ± 0.08
SED17-09	92.0 ± 11.0	37.8 ± 9.8*(a)(c)	8.1 ± 1.3*(a)(c)	0.38 ± 0.07*(a)(c)
SED17-13	100.0 ± 0.0	45.9 ± 6.2	9.2 ± 1.2	0.43 ± 0.06
SED17-17	96.0 ± 8.9	50.5 ± 11.1	10.4 ± 1.7	0.50 ± 0.08
SED17-20	84.0 ± 16.7	38.8 ± 10.7 (c)	9.1 ± 1.3	0.43 ± 0.07
SED17-18	96.0 ± 8.9	39.0 ± 2.5*(a)(c)	8.2 ± 1.2*(a)(c)	0.39 ± 0.06*(a)(c)
SED17-19	80.0 ± 28.3	32.5 ± 13.7*(a)(c)	8.0 ± 1.5*(a)(c)	0.37 ± 0.08*(a)(c)
SED17-24	100.0 ± 0.0	48.3 ± 5.8	9.7 ± 1.2	0.46 ± 0.06
SED17-12	96.0 ± 8.9	38.9 ± 3.6*(a)(c)	8.2 ± 1.4*(c)	0.38 ± 0.07*(c)
SED17-01	96.0 ± 8.9	45.5 ± 4.6	9.6 ± 1.4	0.45 ± 0.07
SED17-03	96.0 ± 8.9	42.0 ± 7.6	8.8 ± 1.4 (c)	0.41 ± 0.07 (c)
SED17- 29	100.0 ± 0.0	42.3 ± 6.7	8.5 ± 1.3*(c)	0.40 ± 0.07*(c)
SED17-27	96.0 ± 8.9	53.4 ± 13.4	11.0 ± 2.0	0.52 ± 0.10

1. SD = standard deviation; asterisks (*) indicate samples with mean survival significant lower (p <0.05) than their respective control.
   (a) indicates samples with mean survival significant lower (p <0.05) than reference sample SED17-24
   (b) indicates samples with mean survival significant lower (p <0.05) than reference sample SED17-29
   (c) indicates samples with mean survival significant lower (p <0.05) than reference sample SED17-27

3.2.2 Quality Assurance / Quality Control

There were no issues identified by the laboratory in terms of data quality. A comprehensive report to supplement the raw analytical appendices provided in Appendix E is still in progress.

3.3 Tissue Chemistry in Aquatic Biota

Copies of the ALS laboratory reports for the sediment chemistry analyses performed on the samples are provided in Appendix D, and a tissue chemistry data table is provided in Table A-2. Data have not been compared to specific tissue residue guidelines. The tissue collection program collected the following samples (see Figure 3 for sampling locations)

- Near-field (NF): prawns (n=5), mussels (n=5) and crabs (n=3)
- Mid-field: crabs (n=5)
- Far-field: mussels (n=5)
- Reference: prawns (n=3), mussels (n=5) and crabs (n=3)

Each tissue sample was analyzed for metals and PAHs. These data will be evaluated in greater detail as part of the subsequent risk assessment, but some broad observations based on Table A-2 are as follows:

- Tissue concentrations of mercury and zinc varied between species but appeared to show little differences between sample locations (i.e., the concentrations near the ore basin were similar to those measured in reference locations).
- Tissue concentrations of arsenic and lead also varied between species, and appeared to be higher in the samples collected from the ore basin for two specific tissue/substance combinations"
  - Prawns for arsenic
  - Crabs for lead
- The tissue concentrations of copper tended to be similar in all tissue types from all four sampling areas, with the exception of a prawn sample collected from the reference location which contained nearly 4x the copper of the next highest sample.
- Detectable concentrations of PAHs were not detected in crab or prawn tissue samples at any sample locations except for one prawn tissue sample which contained detectable concentrations of a single PAH. Conversely, mussel samples from both the near and far-field sampling locations tended to have detectable concentrations of PAHs, and tended to be higher in the near-field area than in the far-field area. Mussel tissue concentrations of PAHs at the reference location were less than the detection limit except for one mussel tissue sample which contained detectable concentrations of a single PAH.

Golder cautions that any patterns in the tissue data should be interpreted with caution given that the number of samples in any pairwise comparisons are quite limited. Ultimately, any interpretation of these data with respect to management decisions should be based on the risk assessment.

3.3.1 Quality Assurance / Quality Control

There were no laboratory quality assurance/quality control measures that indicated a data quality issue (Appendix D and Appendix G). Overall, Golder concludes that the tissue data are reliable and suitable for the risk assessment based on consideration of both the laboratory and field QA/QC components.

4.0 CLOSURE

The purpose of this report is to provide a summary of the field activities conducted by Golder to support an ecological and human health risk assessment for the Skagway Ore Terminal. Analytical data (tabular summaries and the original certificates of analysis) has been appended per ADEC requirements. No interpretation of these data has been presented at this time. This data report is considered a draft appendix for the ecological and human health risk assessment technical report which is currently in progress and will be finalized as part of that broader deliverable.

GOLDER ASSOCIATES LTD.

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Environmental Scientist

Blair McDonald, MET, RPBio
Associate, Senior Environmental Scientist

VM/BM/lih

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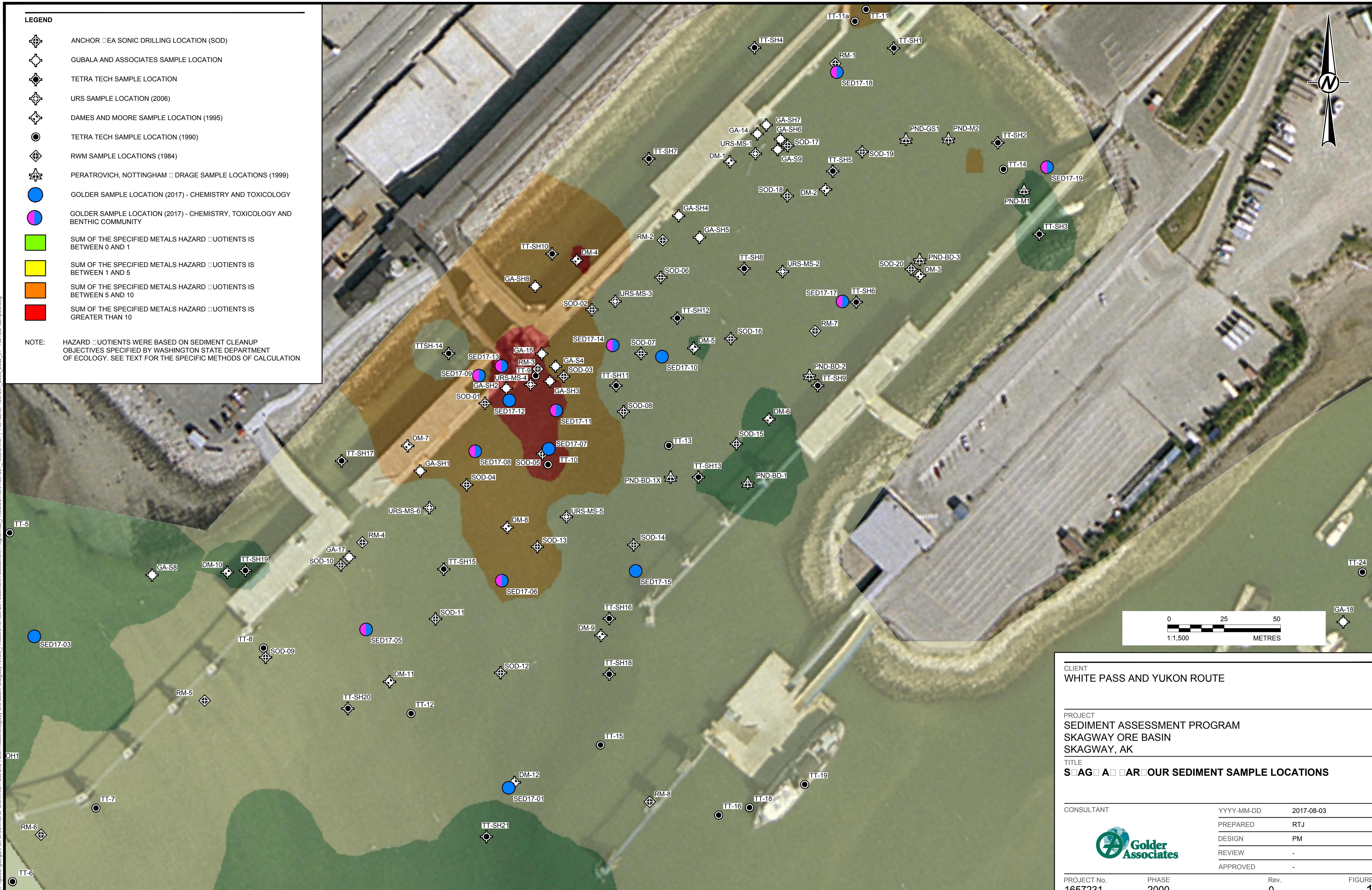

LEGEND
ANCHOR □EA SONIC DRILLING LOCATION (SOD)
GUBALA AND ASSOCIATES SAMPLE LOCATION
TETRA TECH SAMPLE LOCATION
URS SAMPLE LOCATION (2006)
DAMES AND MOORE SAMPLE LOCATION (1995)
TETRA TECH SAMPLE LOCATION (1990)
RWM SAMPLE LOCATIONS (1984)
PERATROVICH, NOTTINGHAM □ DRAGE SAMPLE LOCATIONS (1999)
GOLDER SAMPLE LOCATION (2017) - CHEMISTRY AND TOXICOLOGY
GOLDER SAMPLE LOCATION (2017) - CHEMISTRY, TOXICOLOGY AND BENTHIC COMMUNITY
SUM OF THE SPECIFIED METALS HAZARD □UOTIENTS IS BETWEEN 0 AND 1
SUM OF THE SPECIFIED METALS HAZARD □UOTIENTS IS BETWEEN 1 AND 5
SUM OF THE SPECIFIED METALS HAZARD □UOTIENTS IS BETWEEN 5 AND 10
SUM OF THE SPECIFIED METALS HAZARD □UOTIENTS IS GREATER THAN 10
NOTE: HAZARD □UOTIENTS WERE BASED ON SEDIMENT CLEANUP OBJECTIVES SPECIFIED BY WASHINGTON STATE DEPARTMENT OF ECOLOGY. SEE TEXT FOR THE SPECIFIC METHODS OF CALCULATION
TT-11a
TT-11
TT-SH4
TT-SH1
RM-1
SED17-18
GA-SH7
GA-SH6
GA-14
URS-MS-1
SOD-17
DM-1
GA-S9
SOD-19
PND-GS1
PND-M2
TT-SH2
TT-SH7
TT-SH5
TT-14
SED17-19
SOD-18
DM-2
PND-M1
GA-SH4
GA-SH5
TT-SH3
RM-2
TT-SH10
DM-4
TT-SH8
URS-MS-2
SOD-20
PND-BD-3
DM-3
GA-SH8
SOD-06
URS-MS-3
SED17-17
TT-SH6
SOD-02
TT-SH12
RM-7
SED17-14
SOD-07
DM-5
SOD-16
TTSH-14
SED17-13
GA-15
RM-3
TT-9
GA-S4
SOD-03
SED17-10
PND-BD-2
TT-SH9
SED17-09
URS-MS-4
TT-SH11
GA-SH2
GA-SH3
SOD-01
SED17-12
SOD-08
SED17-11
DM-6
DM-7
SED17-07
TT-13
SOD-15
TT-SH17
SED17-08
SOD-05
TT-10
GA-SH1
TT-SH13
PND-BD-1
SOD-04
PND-BD-1X
URS-MS-6
URS-MS-5
TT-5
DM-8
RM-4
SOD-13
SOD-14
GA-17
SOD-10
TT-SH15
GA-S8
DM-10
TT-SH19
SED17-15
SED17-06
TT-24
GA-18
TT-SH16
SOD-11
SED17-05
DM-9
SED17-03
TT-8
SOD-09
SOD-12
TT-SH18
DM-11
RM-5
TT-SH20
TT-12
TT-15
OH1
DM-12
SED17-01
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CLIENT
WHITE PASS AND YUKON ROUTE
PROJECT
SEDIMENT ASSESSMENT PROGRAM
SKAGWAY ORE BASIN
SKAGWAY, AK
TITLE
S□AG□ A□ □AR□OUR SEDIMENT SAMPLE LOCATIONS
CONSULTANT
Golder Associates
YYYY-MM-DD 2017-08-03
PREPARED RTJ
DESIGN PM
REVIEW -
APPROVED -
PROJECT No. 1657231
PHASE 2000
Rev. 0
FIGURE 1
25 mm
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

LEGEND

- REFERENCE SAMPLE LOCATION (2008)
- REFERENCE SAMPLE LOCATION (2007)
- PND REFERENCE SAMPLE LOCATION (1999)
- TETRA TECH REFERENCE SAMPLE LOCATION (1990)
- ANCHOR □EA SONIC DRILLING LOCATION (SOD)
- GUBALA AND ASSOCIATES SAMPLE LOCATION
- TETRA TECH SAMPLE LOCATION
- URS SAMPLE LOCATION (2006)
- DAMES AND MOORE SAMPLE LOCATION (1995)
- TETRA TECH SAMPLE LOCATION (1990)
- RWM SAMPLE LOCATIONS (1984)
- GOLDER SAMPLE LOCATION (2017) - CHEMISTRY AND TOXICOLOGY
- GOLDER SAMPLE LOCATION (2017) - CHEMISTRY, TOXICOLOGY AND BENTHIC COMMUNITY

REFERENCE

BASE IMAGERY PROVIDED BY ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

0 500 1,000
1:20,000 METRES

CLIENT
WHITE PASS AND YUKON ROUTE

PROJECT
SEDIMENT ASSESSMENT PROGRAM
SKAGWAY ORE BASIN
SKAGWAY, AK

TITLE
S□AG□A□ SEDIMENT SAMPLING O□ER□IE□ □IT□ FAR□FIELD AND REFERENCE SAMPLE LOCATIONS

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-08-03
PREPARED	RTJ
DESIGN	PM
REVIEW	-
APPROVED	-

PROJECT No.	PHASE	Rev.	FIGURE
1657231	2000	0	2

LEGEND

- CRAB TISSUE SAMPLE LOCATION
- PRAWN TISSUE SAMPLE LOCATION
- CRAB AND PRAWN TISSUE SAMPLE LOCATION
- MUSSEL TISSUE COLLECTION AREA

REFERENCE

BASE IMAGERY PROVIDED BY ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

0 100 200
1:4,000 (DETAIL) METRES

0 500 1,000
1:20,000 METRES

CLIENT
WHITE PASS AND YUKON ROUTE

PROJECT
SEDIMENT ASSESSMENT PROGRAM
SKAGWAY ORE BASIN
SKAGWAY, AK

TITLE
GOLDER 2017 TISSUE SAMPLE LOCATIONS

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-08-03
PREPARED	RTJ
DESIGN	PM
REVIEW	-
APPROVED	-

PROJECT No.	PHASE	Rev.	FIGURE
1657231	2000	0	3

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Path: \\golder.gds\gal\Fort St John\CAD-GIS\White Pass and Yukon Route\Skagway Ore Basin, Skagway AK\99_PROJECTS\1657231 Sediment Assessment Program\02_PRODUCTION\1657231_10502\DWG\ | File Name: 1657231_2000_2002_03 - Tissue Sample.dwg

APPENDIX A

Data Screening

TABLE A-1: Results of the Surface Sediment Samples from Stations within the Vicinty Skagway Harbour and Reference Areas (August 2017)

Location	Marine Sediment AETs [1]		Units	Ore Basin															
Sampling Zone				Zone A				Zone B					Zone C			Zone D			
Sample Name				SED17-07	SED17-11	SED17-12	SED17-13	SED17-06	SED17-08	SED17-09	SED17-10	SED17-14	SED17-05	SED17-17	SED17-18	SED17-01	SED17-03	SED17-15	SED17-19
Sample Date				04/05/2017	30/04/2017	04/05/2017	29/04/2017	26/04/2017	26/04/2017	29/04/2017	05/05/2017	30/04/2017	25-Apr-2017	30/04/2017	02/05/2017	04/05/2017	05/05/2017	05/05/2017	02/05/2017
Laboratory sample ID	SCO	CSL		K1704542-001	K1704415-006	K1704542-002	K1704415-004	K1704246-003	K1704246-002	K1704415-003	K1704542-007	K1704415-005	K1704246-001	K1704415-007	K1704471-004	K1704542-004	K1704542-005	K1704542-008	K1704471-006
Physical Parameters (%)																			
Percent Solids	-	-	%	83.7	86.5	75.9	53.8	78.3	73.9	55.3	76.8	75.5	75.3	75.9	65.7	72.3	78.5	76.2	60.6
Organic Carbon (mg/kg)																			
Carbon, Total Organic (TOC)	-	-	mg/kg	< 2400	< 2300	< 2500	3200	3000	4300	8100	3600	< 2500	3800	3200	10300	< 2800	< 2500	< 2400	10600
Total Organic Carbon [2]	-	-	%	<0.24	<0.23	<0.25	0.32	0.3	0.43	0.81	0.36	<0.25	0.38	0.32	1.03	<0.28	<0.25	<0.24	1.06
Grain Size (%)																			
Clay	-	-	%	5.76	6.50	9.61	18.5	4.20	7.58	15.0	7.45	11.8	10.9	14.4	13.5	15.6	3.28	7.21	19.6
Silt	-	-	%	15.8	13.9	13.2	67.9	11.4	22.3	55.0	11.3	19.9	31.7	28.8	36.7	53.7	7.24	10.4	54.0
Fines (percent clay + silt)	-	-	%	21.6	20.4	22.8	86.4	15.6	29.8	70.0	18.7	31.6	42.6	43.2	50.1	69.2	10.5	17.6	73.6
Inorganic Parameters (µmol/g)																			
Sulfide, Acid-Volatile	-	-	µmol/g	0.09	0.043	0.125	5.5	< 0.039	0.094	8.39	0.121	0.088	< 0.031	< 0.037	2.43	0.148	0.48	0.207	-
Extractable Metals (µmol/g)																			
Antimony (Sb)-Extractable	-	-	µmol/g	< 0.006	< 0.006	< 0.006	< 0.010	< 0.007	< 0.006	< 0.009	< 0.007	< 0.008	< 0.008	< 0.007	< 0.008	< 0.007	< 0.006	< 0.006	-
Arsenic (As)-Extractable	-	-	µmol/g	< 0.011	< 0.010	< 0.011	< 0.017	< 0.012	< 0.010	< 0.015	< 0.012	< 0.013	< 0.013	< 0.011	< 0.013	< 0.011	< 0.009	< 0.011	-
Cadmium (Cd)-Extractable	-	-	µmol/g	< 0.0004	0.0005	0.0009	0.0016	< 0.0005	0.001	0.0022	< 0.0005	< 0.0005	0.0004	< 0.0005	0.0008	0.0007	< 0.0004	0.0005	-
Chromium (Cr)-Extractable	-	-	µmol/g	0.01	0.014	0.012	0.021	0.008	0.015	0.028	0.009	0.017	0.012	0.014	0.018	0.014	0.007	0.009	-
Copper (Cu)-Extractable	-	-	µmol/g	0.23	0.091	0.407	0.369	0.104	0.172	0.122	0.085	0.113	0.121	0.095	0.041	0.073	0.023	0.058	-
Lead (Pb)-Extractable	-	-	µmol/g	0.324	0.253	0.543	0.94	0.145	0.522	0.706	0.235	0.286	0.226	0.222	0.141	0.177	0.026	0.103	-
Mercury (Hg)-Extractable	-	-	µmol/g	< 0.00008	< 0.00008	< 0.00009	< 0.00014	< 0.00010	< 0.00008	< 0.00012	< 0.00009	< 0.00010	< 0.00008	< 0.00009	< 0.00011	< 0.00009	< 0.00008	< 0.00009	-
Nickel (Ni)-Extractable	-	-	µmol/g	0.007	0.011	0.013	0.02	0.007	0.012	0.029	0.006	0.013	0.011	0.012	0.016	0.013	0.008	0.007	-
Silver (Ag)-Extractable	-	-	µmol/g	< 0.002	< 0.002	< 0.002	< 0.003	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003	< 0.003	< 0.002	< 0.003	< 0.002	< 0.002	< 0.002	-
Zinc (Zn)-Extractable	-	-	µmol/g	0.631	0.724	0.907	1.73	0.356	1.15	1.28	0.43	0.575	0.946	0.674	0.469	0.502	0.13	0.297	-
Sum of SEM (ΣSEM)	-	-	µmol/g	**1.2**	**1.1**	**1.9**	**3.1**	**0.62**	**1.9**	**2.2**	**0.77**	**1.0**	**1.3**	**1.0**	**0.69**	**0.78**	**0.19**	**0.47**	**-**
[SEM]/[AVS]				**13**	**25**	**15**	**0.56**	**-**	**20**	**0.26**	**6.3**	**11**	**-**	**-**	**0.28**	**5.3**	**0.4**	**2.3**	**-**
AVS-ΣSEM	-	-	µmol/g	**-1.1**	**-1.1**	**-1.8**	**2.4**	**-**	**-1.8**	**6.2**	**-0.64**	**-0.92**	**-**	**-**	**1.7**	**-0.63**	**0.29**	**-0.27**	**-**
Metals (mg/kg)																			
Aluminum (Al)	-	-	mg/kg	9090	7210	7880	21100	7660	7950	17400	7580	9690	10800	10800	13300	14200	6020	8220	12600
Antimony (Sb)	-	-	mg/kg	< 0.059	< 0.048	0.213	0.147	<0.057	0.12	0.117	< 0.058	< 0.043	<0.060	< 0.053	0.066	0.096	< 0.056	< 0.048	< 0.063
Arsenic (As)	57	**93**	mg/kg	1.82	1.48	3.76	4.29	1.85	3.69	4.47	1.56	2.06	2.03	2.75	3.37	3.08	1.12	1.94	3.02
Barium (Ba)	-	-	mg/kg	179	139	174	474	163	187	419	154	224	235	281	295	272	101	169	305
Beryllium (Be)	-	-	mg/kg	0.161	0.153	0.136	0.384	0.177	0.212	0.319	0.144	0.198	0.197	0.208	0.276	0.281	0.137	0.18	0.248
Cadmium (Cd)	5.1	**6.7**	mg/kg	0.29	0.197	1.21	1.51	0.214	0.325	1.83	0.265	0.394	0.248	0.342	0.613	0.64	0.078	0.254	0.436
Calcium (Ca)	-	-	mg/kg	3410	3210	14300	7670	2920	9760	11400	12800	4410	6240	6120	9640	4370	4240	7200	147000
Chromium (Cr)	260	**270**	mg/kg	9.05	9.68	18.9	23.5	9.91	12.9	18.6	8.79	12.3	11.7	13.4	16.9	21.1	7.22	11.1	16.7
Cobalt (Co)	-	-	mg/kg	4.4	4.39	6.86	11.4	5.25	6.63	9.18	4.19	5.92	5.66	6.65	8	8.99	4.12	5.17	7.1
Copper (Cu)	390	**390**	mg/kg	33	48	96.2	100	43.2	207	93.5	40.7	62.3	34.3	37.1	46	24.4	10.1	24.5	28.2
Iron (Fe)	-	-	mg/kg	16800	15700	40600	39600	15500	17700	33600	14300	18700	21500	22900	24700	24500	11900	15100	25200
Lead (Pb)	450	**530**	mg/kg	172	85	469	**666**	73.5	**594**	**666**	107	144	82.6	98.9	119	66.5	8.43	66	77.1
Magnesium (Mg)	-	-	mg/kg	5850	4810	5570	13400	5150	5480	11400	4770	6290	7130	7330	8390	8900	4250	5350	8690
Manganese (Mn)	-	-	mg/kg	227	221	370	535	209	258	516	180	259	286	316	329	318	166	198	334
Mercury (Hg)	0.41	**0.59**	mg/kg	0.179	0.077	0.532	0.413	0.071	0.287	**0.821**	0.091	0.126	0.139	0.143	0.152	0.035	< 0.021	0.048	0.129
Nickel (Ni)	-	-	mg/kg	4.55	4.16	15	12.9	5.26	6.3	10.4	4.51	6.3	6.18	7.2	8.82	11.1	4.26	5.85	9.17
Potassium (K)	-	-	mg/kg	4100	2900	3730	10100	3380	3800	8670	3120	4530	4940	6370	6220	6290	2390	3740	6440
Selenium (Se)	-	-	mg/kg	< 1.2	< 0.96	< 0.99	< 1.3	<1.1	<1.1	< 1.1	< 1.2	< 0.85	<1.2	< 1.1	< 1.2	< 1.1	< 1.6	< 0.96	< 1.3
Silver (Ag)	6.1	**6.1**	mg/kg	0.258	0.126	0.584	1.05	0.164	0.521	1.04	0.154	0.209	0.287	0.205	0.33	0.588	0.044	0.119	0.227
Sodium (Na)	-	-	mg/kg	3900	2370	4250	11900	3540	3420	11000	3530	4500	4740	3930	7010	5380	3250	4190	8260
Thallium (Tl)	-	-	mg/kg	0.179	0.143	0.202	0.542	0.192	0.28	0.432	0.152	0.223	0.247	0.254	0.303	0.337	0.122	0.191	0.279
Vanadium (V)	-	-	mg/kg	31	30	29.1	78.3	35.6	42.7	64	29.7	41.3	38.5	44.6	55.7	64.8	26.2	35.8	50.2
Zinc (Zn)	410	**960**	mg/kg	214	125	806	642	114	261	**1040**	143	212	171	192	240	124	40.9	105	174
Polycyclic Aromatic Hydrocarbons (µg/kg dry wt)																			
Low Molecular Weight PAHs																			
Acenaphthene	500	**500**	µg/kg	< 5.9	< 5.8	< 6.4	17	<6.3	<6.2	55	< 6.4	< 6.4	<6.7	< 6.4	15	< 6.8	< 6.2	< 6.3	< 8.2
Acenaphthylene	1300	**1300**	µg/kg	8.3	< 5.8	21	59	<6.3	<6.2	73	9.3	6.4	10	< 6.4	7.9	< 6.8	< 6.2	7.6	13
Anthracene	960	**960**	µg/kg	22	7.9	56	250	13	21	260	36	28	25	20	70	8.7	< 6.2	18	150
Fluorene	540	**540**	µg/kg	6.3	< 5.8	13	110	<6.3	15	89	16	9.6	<6.7	10	29	< 6.8	< 6.2	8.8	28
Naphthalene	2100	**2100**	µg/kg	< 5.9	< 5.8	< 6.4	< 9.1	<6.3	<6.2	< 8.8	< 6.4	< 6.4	<6.7	< 6.4	< 7.6	< 6.8	< 6.2	< 6.3	< 8.2
Phenanthrene	1500	**1500**	µg/kg	35	13	95	470	27	77	610	91	49	33	51	190	14	< 6.2	75	150
2-methylnaphthalene	670	**670**	µg/kg	< 5.9	< 5.8	< 6.4	11	<6.3	<6.2	9.4	< 6.4	< 6.4	<6.7	< 6.4	< 7.6	< 6.8	< 6.2	< 6.3	< 8.2
High Molecular Weight PAHs																			
Benzo(a)anthracene	1300	**1600**	µg/kg	45	88	220	**2200**	46	83	**2300**	120	180	150	140	260	20	8.4	79	450
Benzo(a)pyrene	1600	**1600**	µg/kg	45	50	130	1100	36	40	960	60	79	73	81	140	27	< 6.2	34	210
Benzo(b)fluoranthene	-	-	µg/kg	84	140	270	2500	72	94	2000	120	180	140	180	330	57	< 6.2	69	420
Benzo(g,h,i)perylene	670	**720**	µg/kg	17	15	39	350	12	14	290	17	26	25	27	49	9.7	< 6.2	9.4	73
Benzo(k)fluoranthene	-	-	µg/kg	32	48	97	740	29	37	680	43	78	57	72	120	19	< 6.2	26	180
Chrysene	1400	**2800**	µg/kg	92	54	280	2200	40	150	2100	110	220	150	150	290	36	7.5	61	480
Dibenzo(a,h)anthracene	230	**230**	µg/kg	< 5.9	< 5.8	12	150	<6.3	<6.2	110	< 6.4	< 6.4	8.8	7.9	16	< 6.8	< 6.2	< 6.3	24
Fluoranthene	1700	**2500**	µg/kg	60	52	370	2400	73	150	**11000**	360	710	160	180	800	33	7.6	260	710
Indeno(1,2,3-c,d)pyrene	600	**690**	µg/kg	21	18	47	470	15	17	390	23	34	29	34	62	13	< 6.2	13	95
Pyrene	2600	**3300**	µg/kg	87	60	330	**5700**	51	100	**9000**	230	480	160	110	560	72	< 6.2	170	460
Dibenzofuran	-	-	µg/kg	< 5.9	< 5.8	< 6.4	29	<6.3	<6.2	27	< 6.4	< 6.4	<6.7	< 6.4	13	< 6.8	< 6.2	< 6.3	13
Total benzofluoranthenes	3200	**3600**	µg/kg	116	188	367	3240	101	131	2680	163	258	197	252	450	76	< 6.2	95	600
Total LPAH	5200	**5200**	µg/kg	72	21	185	917	40	113	1096	152	93	68	81	312	23	< 6.2	109	341
Total HPAH	12000	**17000**	µg/kg	483	525	1795	**17839**	374	685	**28857**	1083	1987	952.8	981.9	2640	286.7	23.5	721.4	3115
DRO			µg/kg	< 24	< 25	< 26	44	36	< 27	79	< 26	< 27	< 27	< 27	38	< 28	< 26	< 26	-
RRO			µg/kg	< 120	< 130	< 130	< 190	< 130	< 140	< 180	< 130	< 140	< 140	< 140	< 140	< 140	< 130	< 130	-

Notes

Value — Detected value is greater than marine sediment SCO

Value — Detected value is greater than marine sediment CSL

< Indicates parameter was below laboratory method detection limit.

- Chemical not analyzed or criteria not defined.

1. The SCO represents the long-term sediment quality goal, while the CSL is the maximum chemical concentration or biological effects level allowed as a sediment cleanup level. They are used in conjunction for sediment risk management and remedial planning. The final sediment clean up level (i.e., the basis of design of remediation) is initially set at the more conservative SCO but can be adjusted upwards towards the CSL based on technical feasibility and net adverse environmental impacts as part of the selection of the remedial option.

2 - Percentage TOC

TABLE A-1: Results of the Surface Sediment Samples from Stations within the Vicinty Skagway Harbour and Reference Areas (August 2017)

Location	Marine Sediment AETs [1]		Units	Zone E— Outside Ore Basin but within Skagway Harbour			Zone F—Reference				
Sampling Zone							Dyea Point	Taiya River		Nahku Bay	
Sample Name				SED17-20	SED17-21	SED17-22	SED17-24	SED17-27	SED17-28	SED17-29	SED17-31
Sample Date				01/05/2017	01/05/2017	05/01/2017	02/05/2017	05/05/2017	02/05/2017	05/05/2017	28/04/2017
Laboratory sample ID	SCO	CSL		K1704471-003	K1704471-002	K1704471-001	K1704471-007	K1704542-009	K1704471-008	K1704542-006	K1704415-002
Physical Parameters (%)											
Percent Solids	-	-	%	53.8	62.7	63.7	75.8	79.1	68.1	49.6	47.7
Organic Carbon (mg/kg)											
Carbon, Total Organic (TOC)	-	-	mg/kg	13700	8300	9600	3500	< 2500	6500	24100	21500
Total Organic Carbon[2]	-	-	%	1.37	0.83	0.96	0.35	<0.25	0.65	2.41	2.15
Grain Size (%)											
Clay	-	-	%	9.74	23.5	22.7	9.38	1.75	4.20	18.2	22.1
Silt	-	-	%	54.9	41.4	49.6	46.8	33.1	49.4	70.6	64.2
Fines (percent clay + silt)	-	-	%	64.6	64.9	72.2	56.2	34.8	53.6	88.7	86.3
Inorganic Parameters (µmol/g)											
Sulfide, Acid-Volatile	-	-	µmol/g	-	-	3.58	0.105	0.057	0.198	2.7	-
Extractable Metals (µmol/g)											
Antimony (Sb)-Extractable	-	-	µmol/g	-	-	< 0.009	< 0.008	< 0.006	< 0.006	< 0.011	-
Arsenic (As)-Extractable	-	-	µmol/g	-	-	< 0.014	< 0.013	< 0.011	< 0.010	< 0.019	-
Cadmium (Cd)-Extractable	-	-	µmol/g	-	-	0.0026	< 0.0005	< 0.0004	< 0.0004	0.0032	-
Chromium (Cr)-Extractable	-	-	µmol/g	-	-	0.046	0.016	0.01	0.018	0.028	-
Copper (Cu)-Extractable	-	-	µmol/g	-	-	0.15	0.025	0.008	0.017	0.062	-
Lead (Pb)-Extractable	-	-	µmol/g	-	-	0.318	0.018	0.005	0.008	0.044	-
Mercury (Hg)-Extractable	-	-	µmol/g	-	-	< 0.00011	< 0.00010	< 0.00009	< 0.00008	< 0.00015	-
Nickel (Ni)-Extractable	-	-	µmol/g	-	-	0.042	0.014	0.007	0.014	0.036	-
Silver (Ag)-Extractable	-	-	µmol/g	-	-	< 0.003	< 0.003	< 0.00009	< 0.002	< 0.004	-
Zinc (Zn)-Extractable	-	-	µmol/g	-	-	1.31	0.139	0.064	0.108	0.386	-
Sum of SEM (ΣSEM)	**-**	**-**	µmol/g	**-**	**-**	**1.9**	**0.21**	**0.094**	**0.17**	**0.56**	**-**
[SEM]/[AVS]				**-**	**-**	**0.52**	**2.0**	**1.6**	**0.83**	**0.21**	**-**
AVS-ΣSEM	**-**	**-**	µmol/g	**-**	**-**	**1.7**	**-0.11**	**-0.037**	**0.033**	**2.1**	**-**
Metals (mg/kg)											
Aluminum (Al)	-	-	mg/kg	17800	14800	14700	10600	11500	16200	20500	20500
Antimony (Sb)	-	-	mg/kg	0.295	0.142	0.096	< 0.063	< 0.049	< 0.064	< 0.080	< 0.068
Arsenic (As)	57	**93**	mg/kg	4.58	6.11	4.34	2.77	1.18	2.61	5.2	5.65
Barium (Ba)	-	-	mg/kg	421	339	337	222	147	285	409	450
Beryllium (Be)	-	-	mg/kg	0.359	0.372	0.279	0.201	0.126	0.17	0.374	0.415
Cadmium (Cd)	5.1	**6.7**	mg/kg	0.794	0.623	0.541	0.112	0.072	0.16	0.564	0.564
Calcium (Ca)	-	-	mg/kg	22300	63300	30500	16100	5740	8680	31200	12200
Chromium (Cr)	260	**270**	mg/kg	23.1	24.6	16.9	14	12	16.9	23.8	24.9
Cobalt (Co)	-	-	mg/kg	10.4	9.53	7.7	6.96	4.68	6.66	11.2	11.6
Copper (Cu)	390	**390**	mg/kg	26.5	45.6	82.5	8.68	5.66	8.15	18.3	19
Iron (Fe)	-	-	mg/kg	34800	31000	30400	18700	13000	21900	36100	37800
Lead (Pb)	450	**530**	mg/kg	33.9	29.9	41.6	8.13	3.13	5.06	17	17.2
Magnesium (Mg)	-	-	mg/kg	11500	9730	9380	6090	4560	7600	13400	13200
Manganese (Mn)	-	-	mg/kg	475	403	398	282	179	270	465	492
Mercury (Hg)	0.41	**0.59**	mg/kg	< 0.024	< 0.025	0.034	< 0.015	< 0.018	< 0.026	0.043	< 0.021
Nickel (Ni)	-	-	mg/kg	13.2	13.5	9.56	6.97	5.12	8.42	12.7	13.3
Potassium (K)	-	-	mg/kg	8630	7010	6890	4230	2840	4820	9140	9550
Selenium (Se)	-	-	mg/kg	< 1.4	< 1.3	< 1.3	< 1.3	< 0.98	< 1.3	< 1.6	< 1.3
Silver (Ag)	6.1	**6.1**	mg/kg	1.63	0.281	0.506	0.077	0.039	0.085	0.247	0.257
Sodium (Na)	-	-	mg/kg	11000	8680	7810	4490	3580	6610	13700	14300
Thallium (Tl)	-	-	mg/kg	0.43	0.419	0.326	0.216	0.161	0.249	0.486	0.508
Vanadium (V)	-	-	mg/kg	70.4	61.4	52.5	41.6	28.2	39.6	73.6	77.5
Zinc (Zn)	410	**960**	mg/kg	173	198	196	52.6	35.9	61.9	115	115
Polycyclic Aromatic Hydrocarbons (µg/kg dry wt)											
Low Molecular Weight PAHs											
Acenaphthene	500	**500**	µg/kg	26	< 7.7	< 7.6	< 6.6	< 6.2	< 7.3	< 10	< 11
Acenaphthylene	1300	**1300**	µg/kg	< 9.1	< 7.7	< 7.6	< 6.6	< 6.2	< 7.3	< 10	< 11
Anthracene	960	**960**	µg/kg	32	14	11	< 6.6	< 6.2	< 7.3	< 10	< 11
Fluorene	540	**540**	µg/kg	26	9.9	< 7.6	< 6.6	< 6.2	< 7.3	< 10	< 11
Naphthalene	2100	**2100**	µg/kg	100	< 7.7	< 7.6	< 6.6	< 6.2	< 7.3	< 10	< 11
Phenanthrene	1500	**1500**	µg/kg	66	25	17	< 6.6	< 6.2	< 7.3	< 10	< 11
2-methylnaphthalene	670	**670**	µg/kg	62	< 7.7	< 7.6	< 6.6	< 6.2	< 7.3	< 10	< 11
High Molecular Weight PAHs											
Benzo(a)anthracene	1300	**1600**	µg/kg	86	22	45	< 6.6	< 6.2	< 7.3	23	20
Benzo(a)pyrene	1600	**1600**	µg/kg	45	9.8	37	< 6.6	< 6.2	< 7.3	11	< 11
Benzo(b)fluoranthene	-	-	µg/kg	110	24	80	< 6.6	< 6.2	< 7.3	25	28
Benzo(g,h,i)perylene	670	**720**	µg/kg	19	< 7.7	16	< 6.6	< 6.2	< 7.3	< 10	< 11
Benzo(k)fluoranthene	-	-	µg/kg	42	13	37	< 6.6	< 6.2	< 7.3	< 10	< 11
Chrysene	1400	**2800**	µg/kg	72	40	67	< 6.6	< 6.2	< 7.3	12	< 11
Dibenzo(a,h)anthracene	230	**230**	µg/kg	< 9.1	< 7.7	< 7.6	< 6.6	< 6.2	< 7.3	< 10	< 11
Fluoranthene	1700	**2500**	µg/kg	350	38	43	< 6.6	< 6.2	< 7.3	21	49
Indeno(1,2,3-c,d)pyrene	600	**690**	µg/kg	23	8.3	18	< 6.6	< 6.2	< 7.3	< 10	< 11
Pyrene	2600	**3300**	µg/kg	240	39	63	< 6.6	< 6.2	< 7.3	22	60
Dibenzofuran	-	-	µg/kg	35	9.8	< 7.6	< 6.6	< 6.2	< 7.3	< 10	< 11
Total benzofluoranthenes	3200	**3600**	µg/kg	152	37	117	< 6.6	< 6.2	< 7.3	25	28
Total LPAH	5200	**5200**	µg/kg	312	49	28	< 6.6	< 6.2	< 7.3	< 10	< 11
Total HPAH	12000	**17000**	µg/kg	1022	203.9	406	< 6.6	< 6.2	< 7.3	114	157
DRO			µg/kg	-	-	ND	ND	< 26	ND	< 37	< 42
RRO			µg/kg	-	-	ND	ND	< 130	ND	< 190	< 210

Notes

Value	Detected value is greater than marine sediment SCO
Value	Detected value is greater than marine sediment CSL

< Indicates parameter was below laboratory method detection limit.

- Chemical not analyzed or criteria not defined.

1. The SCO represents the long-term sediment quality goal, while the CSL is the maximum chemical concentration or biological effects level allowed as a sediment cleanup level. They are used in conjunction for sediment risk management and remedial planning. The final sediment clean up level (i.e., the basis of design of remediation) is initially set at the more conservative SCO but can be adjusted upwards towards the CSL based on technical feasibility and net adverse environmental impacts as part of the selection of the remedial option.

2 - Percentage TOC calculated at 1% = 10,000 ppm or mg/kg

Location	Units													
Sampling Zone		Near-Field												
Sample Name		NF-PRAWN-01	NF-PRAWN-02	NF-PRAWN-03	NF-PRAWN-04	NF-PRAWN-05	NF-MUSSEL-01	NF-MUSSEL-02	NF-MUSSEL-03	NF-MUSSEL-04	NF-MUSSEL-05	NF-CRAB-01	NF-CRAB-02	NF-CRAB-03
Sample Date		03/05/2017	03/05/2017	04/05/2017	04/05/2017	04/05/2017	29/04/2017	29/04/2017	29/04/2017	29/04/2017	29/04/2017	01/05/2017	04/05/2017	04/05/2017
Laboratory Sample ID		K1704545-001	K1704545-002	K1704545-003	K1704545-004	K1704545-005	K1704545-006	K1704545-007	K1704545-008	K1704545-009	K1704545-010	K1704545-011	K1704545-012	K1704545-013
Physical Parameters														
Moisture	%	74	78	79	83	82	81	79	81	80	79	79	79	80
Total Freeze Dry Solids	%	26	22	17	18	18	19	21	19	20	21	21	21	20
Metals														
Aluminum	mg/kg wwt	22	24	2.3	1.0	0.74	13	14	12	15	18	7.0	7.1	10
Antimony	mg/kg wwt	< 0.013	< 0.011	< 0.011	< 0.0085	< 0.0090	< 0.0093	< 0.010	< 0.0095	< 0.0099	< 0.011	< 0.011	< 0.010	< 0.010
Arsenic	mg/kg wwt	4.9	1.2	19	8.7	8.0	2.8	2.6	2.8	2.6	2.9	3.6	4.0	3.8
Barium	mg/kg wwt	3.9	2.3	0.056	0.046	0.042	0.88	1.2	0.96	1.2	1.3	1.2	0.17	0.26
Beryllium	mg/kg wwt	< 0.0053	< 0.0043	< 0.0042	< 0.0034	< 0.0036	< 0.0037	< 0.0041	< 0.0038	< 0.0040	< 0.0042	< 0.0043	< 0.0042	< 0.0040
Cadmium	mg/kg wwt	0.49	0.42	0.083	0.088	0.13	1.2	1.5	1.3	1.4	1.6	0.048	0.11	0.057
Calcium	mg/kg wwt	16000	11800	830	740	615	391	2880	3390	851	670	8040	939	1150
Chromium	mg/kg wwt	0.44	0.53	0.48	0.43	0.45	1.1	0.34	0.22	0.53	0.39	0.2	0.14	0.27
Cobalt	mg/kg wwt	0.063	0.048	0.016	0.0099	0.014	0.1	0.097	0.09	0.1	0.12	0.06	0.077	0.086
Copper	mg/kg wwt	22	20	7.1	8.1	6.4	5.7	1.9	1.7	1.9	1.9	4.0	8.3	12
Iron	mg/kg wwt	80	104	12	22	7.2	77	58	47	58	65	16	33	37
Lead	mg/kg wwt	0.44	1.1	0.026	0.014	0.0081	2.6	3.2	2.0	3.2	4.1	0.25	0.17	0.24
Magnesium	mg/kg wwt	883	557	352	318	353	661	686	680	662	630	621	400	426
Manganese	mg/kg wwt	3.4	4.3	0.48	0.29	0.31	1.9	2.4	2.5	2.1	2.2	1.3	0.5	0.79
Mercury (ng/g)	mg/kg wwt	33	35	23	25	46	18	19	15	19	22	97	74	73
Nickel	mg/kg wwt	0.36	0.35	0.23	0.2	0.2	0.67	0.32	0.28	0.41	0.41	0.11	0.096	0.15
Potassium	mg/kg wwt	2730	2390	2900	2340	2710	2470	2520	2460	2520	2720	3020	3140	2990
Selenium	mg/kg wwt	0.47	0.34	0.29	0.19	0.21	1.1	1.2	1.1	1.1	1.7	0.28	0.61	0.66
Silver	mg/kg wwt	0.44	0.27	0.12	0.087	0.12	0.013	0.014	0.014	0.015	0.015	0.063	0.12	0.12
Sodium	mg/kg wwt	3200	3320	2620	2660	2800	4510	4520	4660	4300	4030	3950	3910	4060
Thallium	mg/kg wwt	< 0.0053	< 0.0043	< 0.0042	< 0.0034	< 0.0036	< 0.0037	< 0.0041	< 0.0038	< 0.0040	< 0.0042	< 0.0043	< 0.0042	< 0.0040
Vanadium	mg/kg wwt	0.14	0.19	< 0.042	< 0.034	< 0.036	0.16	0.2	0.17	0.18	0.25	< 0.043	< 0.042	0.045
Zinc	mg/kg wwt	17	15	13	10.0	11	23	21	18	24	24	36	46	47
PAH														
2-Methylnaphthalene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0
Acenaphthene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0
Acenaphthylene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0
Anthracene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0
Benz(a)anthracene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	8.5	11	9.1	9.4	13	< 5.0	< 5.0	< 5.0
Benzo(a)pyrene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0
Benzo(b)fluoranthene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	11	12	9.7	12	15	< 5.0	< 5.0	< 5.0
Benzo(g,h,i)perylene	ug/kg wwt	< 5.1	22	< 8.4	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0
Benzo(k)fluoranthene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	5.5	7.5	< 5.0	< 5.0	< 5.0
Chrysene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	13	16	13	15	20	< 5.0	< 5.0	< 5.0
Dibenz(a,h)anthracene	ug/kg wwt	< 5.1	5.7	< 8.4	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0
Dibenzofuran	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0
Fluoranthene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	50	49	51	53	81	< 5.0	< 5.0	< 5.0
Fluorene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	< 5.5	5.3	< 5.0	5.1	6.1	< 5.0	< 5.0	< 5.0
Indeno(1,2,3-cd)pyrene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0
Naphthalene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0	< 5.5	< 5.0	< 5.0	< 5.0
Phenanthrene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	33	40	35	38	51	< 5.0	< 5.0	< 5.0
Pyrene	ug/kg wwt	< 5.1	< 5.0	< 8.4	< 5.0	< 5.0	30	25	31	29	44	< 5.0	< 5.0	< 5.0

Notes

% = percent; mg/kg wwt = milligrams per kilogram wet weight; µg/kg wwt = micrograms per kilogram wet weight

O:\Final\2016\3 Proj\1657231 WPYR_Ore Basin Sediment_Alaska\1657231-004-R-Rev0\APP\APP A - Screened Results\
Tables A-1 and A-2.xlsx
TBL A-2_Tissue Chem

Location	Units	Mid-Field					Far-Field				
Sampling Zone		Mid-Field					Far-Field				
Sample Name		MF-CRAB-01	MF-CRAB-02	MF-CRAB-03	MF-CRAB-04	MF-CRAB-05	FF-MUSSEL-01	FF-MUSSEL-02	FF-MUSSEL-03	FF-MUSSEL-04	FF-MUSSEL-05
Sample Date		03/05/2017	03/05/2017	03/05/2017	03/05/2017	03/05/2017	29/04/2017	29/04/2017	29/04/2017	29/04/2017	29/04/2017
Laboratory Sample ID		K1704545-014	K1704545-015	K1704545-016	K1704545-017	K1704545-018	K1704545-019	K1704545-020	K1704545-021	K1704545-022	K1704545-023
Physical Parameters											
Moisture	%	79	87	84	79	86	80	68	79	80	75
Total Freeze Dry Solids	%	21	14	16	21	14	20	32	21	20	25
Metals											
Aluminum	mg/kg wwt	7.5	5.7	5.9	8.6	2.9	19	16	32	26	17
Antimony	mg/kg wwt	< 0.010	< 0.0067	< 0.0082	< 0.011	< 0.0069	< 0.010	< 0.016	< 0.011	< 0.0099	< 0.012
Arsenic	mg/kg wwt	4.4	1.8	3.1	3.1	1.9	2.7	2.1	2.7	2.6	2.5
Barium	mg/kg wwt	0.25	0.11	0.14	0.38	0.091	3.0	4.8	2.1	1.3	1.9
Beryllium	mg/kg wwt	< 0.0042	< 0.0027	< 0.0033	< 0.0042	< 0.0028	< 0.0041	< 0.0065	< 0.0042	< 0.0040	< 0.0049
Cadmium	mg/kg wwt	0.089	0.12	0.19	0.031	0.019	1.3	0.94	1.6	1.5	1.3
Calcium	mg/kg wwt	1450	1210	1100	2350	1270	1620	62500	7110	634	22400
Chromium	mg/kg wwt	0.087	0.84	0.2	0.32	0.11	0.38	0.48	0.37	0.44	0.29
Cobalt	mg/kg wwt	0.07	0.07	0.072	0.084	0.083	0.11	0.083	0.15	0.11	0.1
Copper	mg/kg wwt	6.0	6.7	7.0	8.4	6.5	1.8	1.4	1.9	1.6	1.5
Iron	mg/kg wwt	17	17	16	22	7.1	51	47	72	66	49
Lead	mg/kg wwt	0.28	0.034	0.045	0.023	0.044	0.24	0.21	0.41	0.33	0.28
Magnesium	mg/kg wwt	426	368	319	431	327	629	630	664	727	715
Manganese	mg/kg wwt	0.68	0.33	0.41	0.76	0.21	4.7	3.8	6.7	2.6	3.8
Mercury (ng/g)	mg/kg wwt	95	30	69	74	32	17	15	19	17	15
Nickel	mg/kg wwt	0.067	0.39	0.13	0.17	0.06	0.4	0.36	0.59	0.36	0.34
Potassium	mg/kg wwt	3320	1980	2770	3170	2080	2620	2160	2500	2660	2550
Selenium	mg/kg wwt	0.7	0.25	0.63	0.58	0.39	1.1	0.94	1.3	0.99	1.1
Silver	mg/kg wwt	0.079	0.12	0.084	0.12	0.11	0.027	0.016	0.027	0.027	0.017
Sodium	mg/kg wwt	4050	6880	5190	4280	6550	4200	4310	4360	4710	4430
Thallium	mg/kg wwt	< 0.0042	< 0.0027	< 0.0033	< 0.0042	< 0.0028	< 0.0041	< 0.0065	< 0.0042	< 0.0040	< 0.0049
Vanadium	mg/kg wwt	< 0.042	< 0.027	0.034	< 0.042	< 0.028	0.17	0.26	0.92	0.31	0.34
Zinc	mg/kg wwt	44	24	31	45	24	23	15	22	18	16
PAH											
2-Methylnaphthalene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Acenaphthene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Acenaphthylene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Anthracene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benz(a)anthracene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzo(a)pyrene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzo(b)fluoranthene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzo(g,h,i)perylene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzo(k)fluoranthene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chrysene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Dibenz(a,h)anthracene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Dibenzofuran	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Fluoranthene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	11	13	12	14	16
Fluorene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Indeno(1,2,3-cd)pyrene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Naphthalene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Phenanthrene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	11	11	11	12	12
Pyrene	ug/kg wwt	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	5.2	5.4	6.1	6.8

Notes

% = percent; mg/kg wwt = milligrams per kilogram wet weight; µg/kg wwt = micrograms per kilogram wet weight

Location		Reference										
Sampling Zone		Reference										
Sample Name	Units	REF-MUSSEL-01	REF-MUSSEL-02	REF-MUSSEL-03	REF-MUSSEL-04	REF-MUSSEL-05	REF-PRAWN-01	REF-PRAWN-02	REF-PRAWN-03	REF-CRAB-01	REF-CRAB-02	REF-CRAB-03
Sample Date		29/04/2017	29/04/2017	29/04/2017	29/04/2017	29/04/2017	04/05/2017	05/05/2017	05/05/2017	29/04/2017	29/04/2017	05/05/2017
Laboratory Sample ID		K1704545-024	K1704545-025	K1704545-026	K1704545-027	K1704545-028	K1704545-029	K1704545-030	K1704545-031	K1704545-032	K1704545-033	K1704545-034
Physical Parameters												
Moisture	%	78	76	81	79	83	79	82	79	84	77	84
Total Freeze Dry Solids	%	22	25	19	21	17	21	18	21	16	23	16
Metals												
Aluminum	mg/kg wwt	51	49	32	20	32	1.2	1.4	1.3	7.2	7.5	6.7
Antimony	mg/kg wwt	< 0.011	< 0.012	< 0.0095	< 0.011	< 0.0087	< 0.010	< 0.0089	< 0.011	< 0.0080	< 0.012	< 0.0079
Arsenic	mg/kg wwt	2.6	3.0	2.1	2.3	2.1	5.9	4.3	5.0	3.5	4.9	5.5
Barium	mg/kg wwt	1.8	1.9	1.2	1.2	1.3	0.06	0.084	0.061	0.16	0.3	0.17
Beryllium	mg/kg wwt	< 0.0045	< 0.0049	< 0.0038	< 0.0043	< 0.0035	< 0.0042	< 0.0035	< 0.0042	< 0.0032	< 0.0046	< 0.0032
Cadmium	mg/kg wwt	1.2	1.5	1.1	1.3	0.94	0.17	0.11	0.089	0.11	0.043	0.057
Calcium	mg/kg wwt	2310	2160	635	6700	1330	886	818	873	1380	1220	1120
Chromium	mg/kg wwt	0.21	0.27	0.36	0.24	0.34	0.33	1.0	0.36	0.21	0.25	0.11
Cobalt	mg/kg wwt	0.13	0.14	0.095	0.093	0.1	0.016	0.029	0.013	0.1	0.075	0.094
Copper	mg/kg wwt	1.5	2.0	3.0	1.5	2.1	7.4	70	7.2	8.4	8.4	11
Iron	mg/kg wwt	106	106	75	50	76	7.7	242	14	18	20	15
Lead	mg/kg wwt	0.11	0.12	0.1	0.088	0.079	0.0051	0.0043	< 0.0042	0.017	0.018	0.01
Magnesium	mg/kg wwt	578	609	528	542	450	411	337	410	403	396	414
Manganese	mg/kg wwt	3.6	3.8	2.3	2.4	2.5	0.38	0.53	0.42	0.36	1.3	0.58
Mercury (ng/g)	mg/kg wwt	13	15	12	11	11	20	24	29	63	72	122
Nickel	mg/kg wwt	0.38	0.44	0.43	0.34	0.43	0.15	0.53	0.17	0.12	0.14	0.075
Potassium	mg/kg wwt	2790	2810	2480	2530	1790	3150	2630	3150	2610	3470	2330
Selenium	mg/kg wwt	1.3	1.6	1.3	1.1	1.2	0.28	0.31	0.27	0.5	0.61	0.53
Silver	mg/kg wwt	0.023	0.036	0.026	0.019	0.019	0.15	0.11	0.16	0.18	0.19	0.26
Sodium	mg/kg wwt	-	3420	3010	3110	2450	3250	2580	2720	5470	3850	5130
Thallium	mg/kg wwt	< 0.0045	< 0.0049	< 0.0038	< 0.0043	< 0.0035	< 0.0042	< 0.0035	< 0.0042	< 0.0032	< 0.0046	< 0.0032
Vanadium	mg/kg wwt	0.54	0.57	0.25	0.17	0.35	< 0.042	< 0.035	< 0.042	0.035	< 0.046	0.033
Zinc	mg/kg wwt	19	22	19	18	17	14	11	13	32	49	40
PAH												
2-Methylnaphthalene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Acenaphthene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Acenaphthylene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Anthracene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benz(a)anthracene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzo(a)pyrene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzo(b)fluoranthene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzo(g,h,i)perylene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzo(k)fluoranthene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chrysene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Dibenz(a,h)anthracene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Dibenzofuran	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Fluoranthene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Fluorene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Indeno(1,2,3-cd)pyrene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Naphthalene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Phenanthrene	ug/kg wwt	8.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Pyrene	ug/kg wwt	< 5.0	< 5.0	< 5.6	< 6.1	< 5.0	< 7.8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

Notes

% = percent; mg/kg wwt = milligrams per kilogram wet weight; µg/kg wwt = micrograms per kilogram wet weight

O:\Final\2016\3 Proj\1657231 WPYR_Ore Basin Sediment_Alaska\1657231-004-R-Rev0\APP\APP A - Screened Results\
Tables A-1 and A-2.xlsx
TBL A-2_Tissue Chem

APPENDIX B

Site Photographs

Photo 1: The Shoreline of Nahku Bay.

Photo 2: Overview of the Skagway Harbour Area (Ore Dock is Far-Right) .

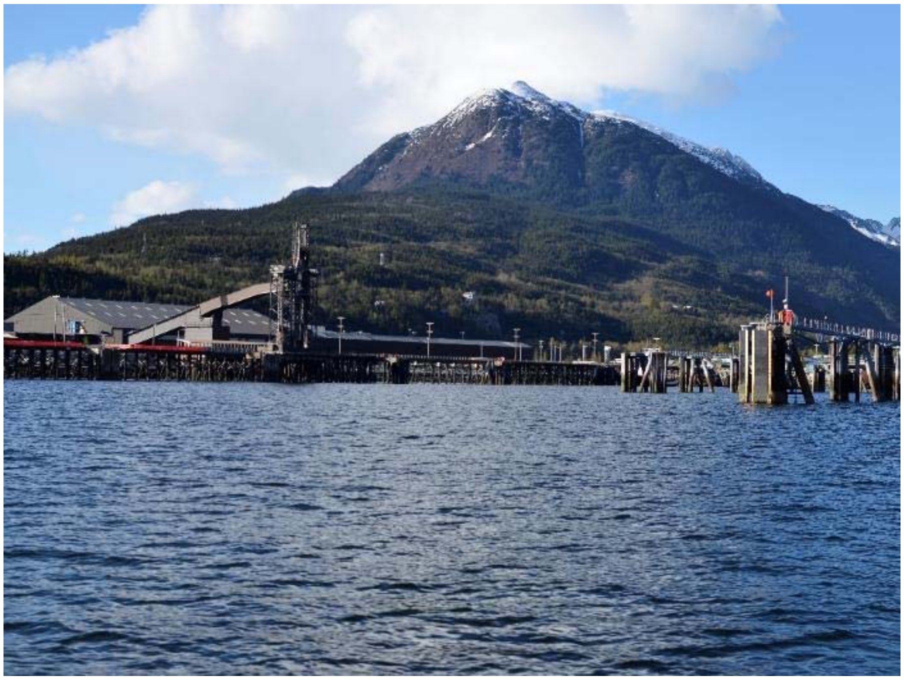

Photo 3: Ore Dock (Left) and Broadway Dock (Right).

Photo 4: Broadway Dock.

Photo 5: Sheetpile Wall Facing Skagway Small Craft Harbour

Photo 6: Nahku Point.

Photo 7: Depiction of Work Area and Van Veen Sampler in Use

Photo 8: Depiction of Sample Processing.

Photo 9: Transfer of Homogenized Sediment to Sample Containers.

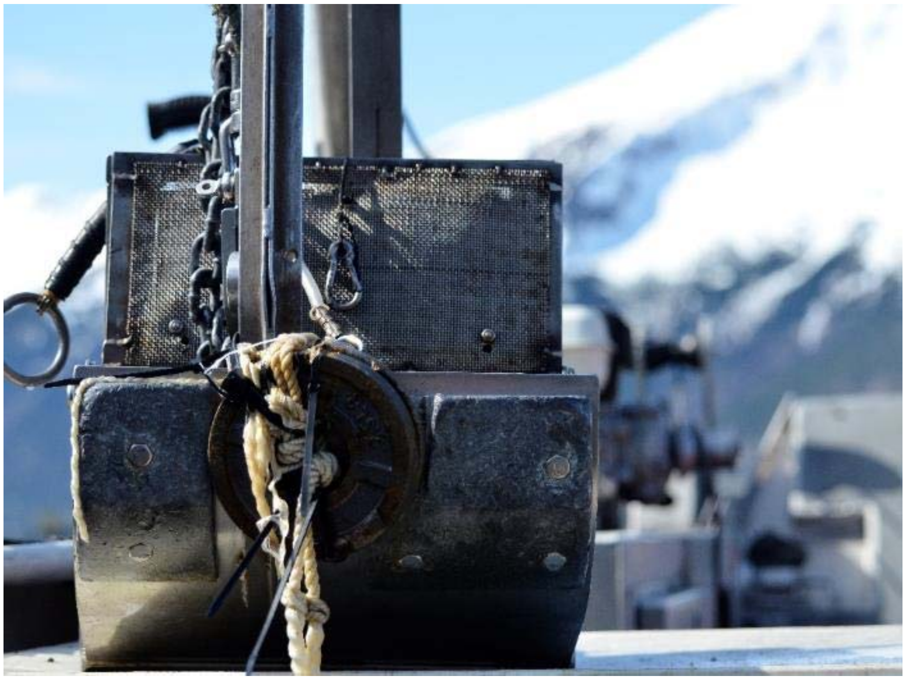

Photo 10: Depiction of Additional Weight Added to Van Veen.

Photo 11: Depiction of Crab Trap Used in Sampling.

Photo 12: Representative Photo of a Collected Dungeness Crab (Top).

Photo 13: Representative Photo of a Male Dungeness Crab (Bottom).

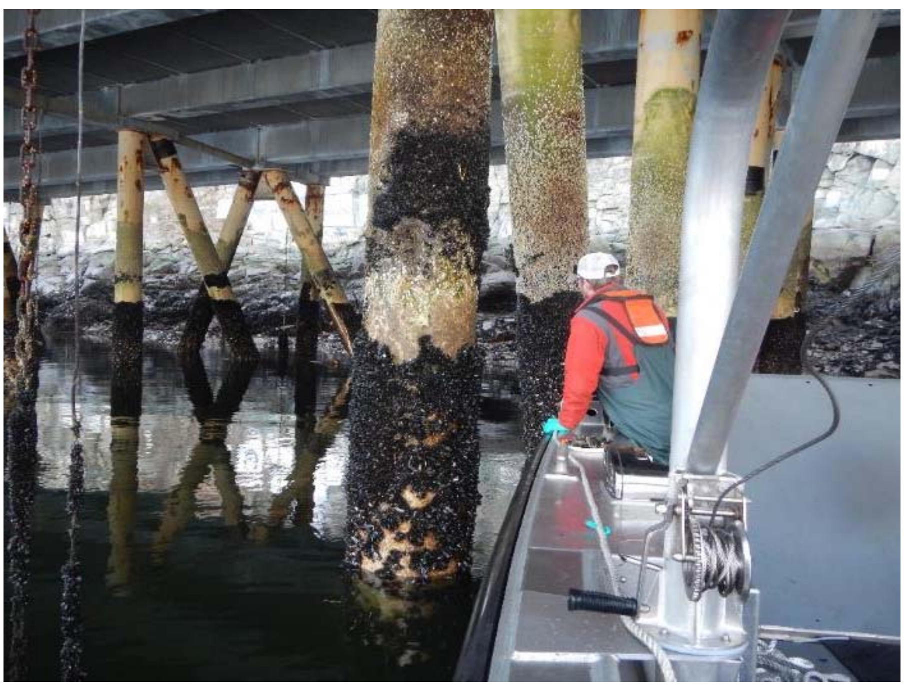

Photo 14: Mussel Tissue Collection at FF Location During Low Tide.

Photo 15: Representative Mussel Sample

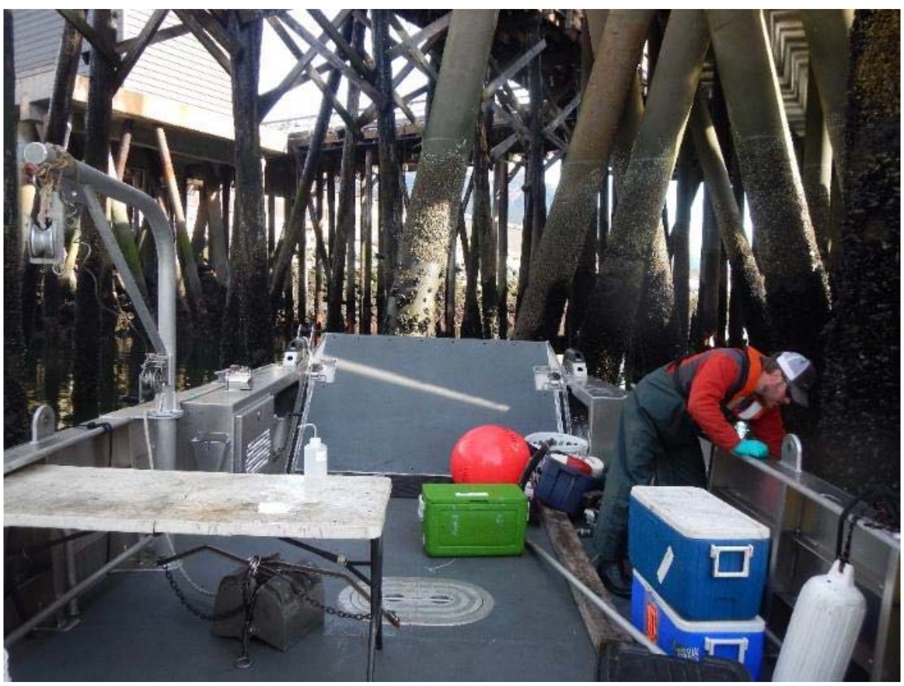

Photo 16: Mussel Tissue Collection at NF Location During Low Tide.

Photo 17: Mussel Tissue Collection at REF Location During Low Tide

Photo 18: Shucking Mussel Samples for Submission to ALS.

Photo 19: Representative Photo of Sediment Collected at SED17-01.

Photo 20: Representative Photo of Sediment Collected at SED17-03.

Photo 21: Representative Photo of Sediment Collected at SED17-05.

Photo 22: Representative Photo of Sediment Collected at SED17-06.

Photo 23: Representative Photo of Sediment Collected at SED17-07.

Photo 24: Egg Mass Surrounded by Small Amphipods Collected at SED17-07.

Photo 25: Amphipod Collected at SED17-07.

Photo 26: Representative Photo of Sediment Collected at SED17-08.

Photo 27: Worm Casing Collected at SED17-08.

Photo 28: Representative Photo of Sediment Collected at SED17-09.

Photo 29: Sheen Observed in Sediment Sample Collected at SED17-09.

Photo 30: Representative Photo of Sediment Collected at SED17-10.

Photo 31: Representative Photo of Sediment Collected at SED17-11.

Photo 32: Ore Dock Viewed from SED17-11.

Photo 33: Representative Photo of Sediment With Sheen Collected at SED17-12.

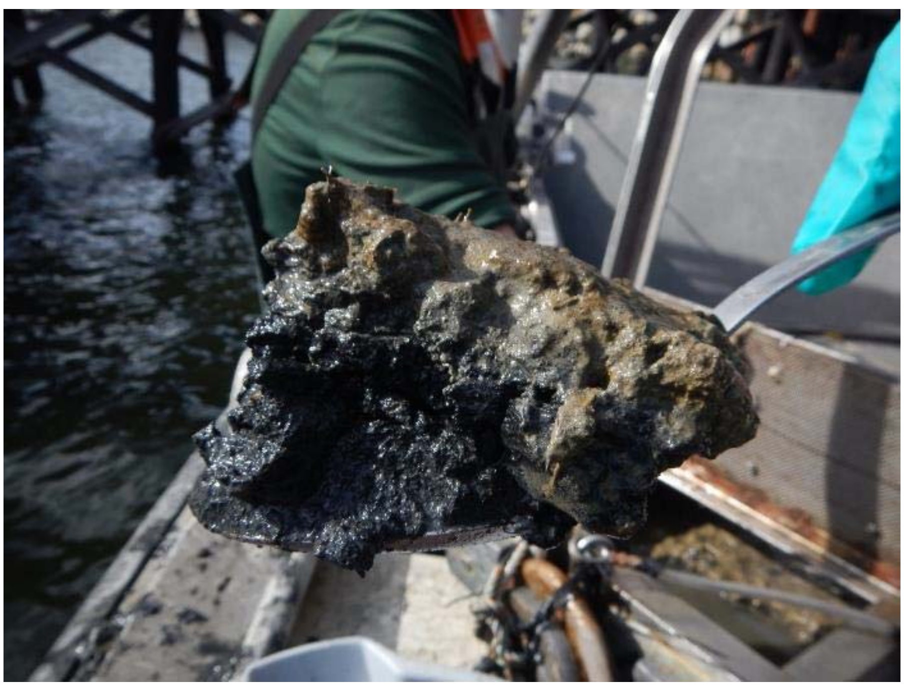

Photo 34: Representative Photo of Sediment Collected at SED17-13.

Photo 35: Representative Photo of Sediment Collected at SED17-14.

Photo 36: Representative Photo of Sediment Collected at SED17-15.

Photo 37: Representative Photo of Sediment Collected at SED17-17.

Photo 38: Ore Dock Viewed from SED17-18.

Photo 39: Representative Photo of Sediment Collected at SED17-19.

Photo 40: Broadway Dock, Outlet of Pullen Creek and Sample Location SED17-19.

Photo 41: Representative Photo of Sediment Collected at SED17-20.

Photo 42: Representative Photo of Sediment Collected at SED17-21.

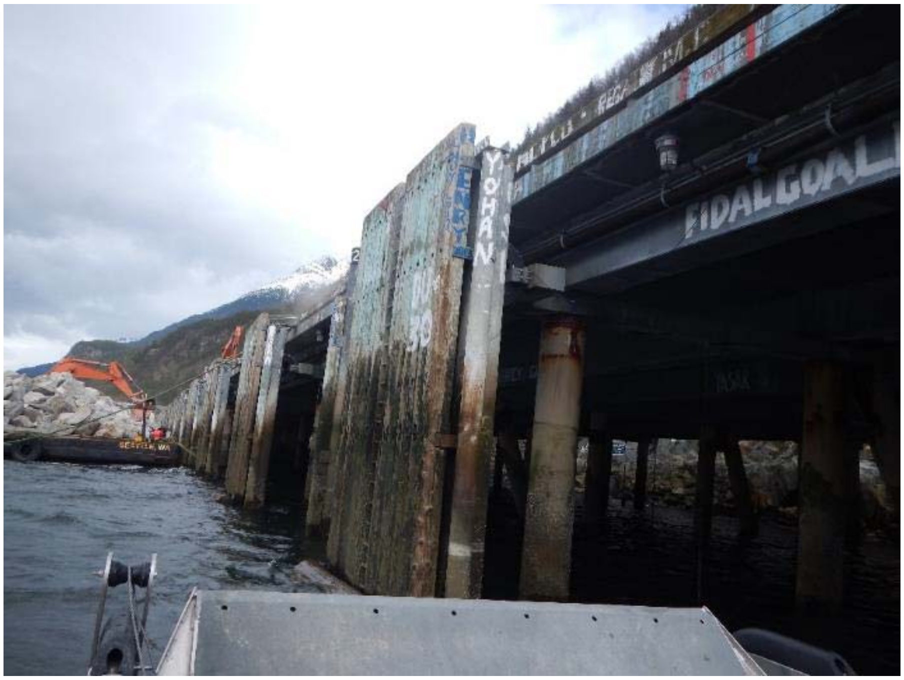

Photo 43: Representative Photo of Railway Dock Taken from SED17-21.

Photo 44: Railway Dock.

Photo 45: Representative Photo of Sediment Collected at SED17-22.

Photo 46: Representative Photo of Sediment Collected at SED17-24.

Photo 47: Representative Photo of Sediment Collected at SED17-27.

Photo 48: Representative Photo of Sediment Collected at SED17-28.

Photo 49: Representative Photo of Sediment Collected at SED17-29.

Photo 50: Representative Photo of Sediment Collected at SED17-31.

Photo 51: Representative Photo of Spot Prawn Collected at NF Sample Location.

Photo 52: Representative Photo of Sea Urchins Collected at NF Sample Location.

Photo 53: Representative Photo Tiger Shrimp Collected at NF Sample Location.

Photo 54: Representative Photo of Sculpin Collected at NF Sample Location.

APPENDIX C

Field Records

Crab Processing Log

Job: Skagway sediment investigation
Job No. ~~1405529/7000~~ 1657231
Processing Staff: JM / PM
Total # of crabs collected at station: 5
Genus and species: Dungeness crab

Station ID: Mid Field (MF)
Collection Date/Time: 3 May 17
Processing Date/Time: 9 am
Collection Method: Crab traps

Crab Tag No.	Time	Carapace Width (mm)	Whole Organism Weight (g)	Sex	Abnormalities	Composite No.	Notes
/	9 am	185	7300g	M	slight darkening of form	1	From WP432 processed
/		171				2	From WP432
/		206				3	From WP433
/		192			has barnacle on shell	4	
/		163				5	

Sample Containers:

Analyses: Tissue

Notes: Comp 4 is missing a claw

Job: Skagway sediment investigation | Station ID: Ref

Job No. ~~1405529/7000~~ 1657271 | Collection Date/Time: 29 MAR 17 & 5 MAY 17

Processing Staff: JM / PM | Processing Date/Time: 10:20am

Total # of crabs collected at station: 3 | Collection Method: crab pots w/ bait

Genus and species: Dungeness Crab

Crab Tag No.	Time	Carapace Width (mm)	Whole Organism Weight (g)	Sex	Abnormalities	Composite No.	Notes
1	10:20	205	>300g	M	none	1	Processed - pitted
2	10:20	166	>300g	M	none	2	Processed - pitted
5 MAY 17 3	8:55	196	>300g	M	none (A)	3	Processed - [illegible]

Sample Containers: Plastic bags w/ 15 in foil

Analyses: Tissue chem

Notes: (A) tips of legs missing

Job: Skagway sediment investigation
Station ID: New - Roll

Job No. 14~~05529/7000~~ 1657231
Collection Date/Time: 28APR17 & 4MAY17

Processing Staff: SAJ / PAJ
Processing Date/Time:

Total # of crabs collected at station: 5
Collection Method:

Genus and species: Dungeness crab

Crab Tag No.	Time	Carapace Width (mm)	Whole Organism Weight (g)	Sex	Abnormalities	Composite No.	Notes
	7:30 28Apr17	175	>300g	F	none	0 (-)	released
I	8:00 1May17	191	>300g	M	Rotten patch on leg	1	processed
	7:30 4MAY17	191	>300g	M	none	2	WP442 - processed
	7:30 4MAY17	179	>300g	M	none	3	WP444 - processed
	7:30 4May17	157	>300g	F	none -> small part at last joint of right 1st leg is missing		WP445 - released

Sample Containers: Plastic Bag w/ Aluminum Foil

Analyses: Tissue Chem

Notes:

Mussel Processing Log

Job: Skagway sediment investigation	Station ID: Near Field (NF)
Job No. ~~1405529/7000~~ 1657231	Collection Date/Time: 29 APR 17
Processing Staff: PM / JM	Processing Date/Time: ~~31~~ 30 APR 17
Total # of clams collected at station: 46	Collection Method: By hand
Genus and species: Blue Mussel	

Clam Tag No.	Species	Width (mm)	Whole Organism Weight (g)	Time	Abnormalities	Composite No.	Notes
	Blue	69 72					
	mussels	73 53					
		64 45					
		58 50					
		58 61					
		62 65					
		57 70					
		62 53					
		63 54					
		63 56					
		62 43					
		54 61					
		52 68					
		53 62					
		61 48					
		72 63					
		63 64					
		61 78					
		58 72					
		52 52					
		45					
		49					
		58					
		51					
		63					

Sample Containers:

Analyses: Tissue chem

Notes: Mussels divided into 5 reps of 30g ea

Mussel Processing Log

Job: Skagway sediment investigation	Station ID: Red
Job No. ~~1405529/7000~~ 1657231	Collection Date/Time: 29 APR 17
Processing Staff: PM/ JM	Processing Date/Time: 30 APR 17
Total # of clams collected at station: 39	Collection Method: By hand
Genus and species: Blue Mussel	

Clam Tag No.	Species	Width (mm)	Whole Organism Weight (g)	Time	Abnormalities	Composite No.	Notes
	Blue	61 51	not				
	Mussels	59 56	weighted				
		55 48					
		45 61					
		52 60					
		53 59					
		54 56					
		68 51					
		46 44					
		69 52					
		68 58					
		58 46					
		60 48					
		57 57					
		58					
		56					
		58					
		61					
		55					
		62					
		48					
		65					
		52					
		50					
		48					

Sample Containers:

Analyses: Tissue Chem

Notes: Mussels divided into 5 reps of 30g ea

Mussel Processing Log

Job: Skagway sediment investigation | Station ID: Fot

Job No. ~~1405529/000~~ 1657231 | Collection Date/Time: 29 APR 17

Processing Staff: PM / JM | Processing Date/Time: 30 APR 17 / 8:45 pm

Total # of clams collected at station: 42 | Collection Method:

Genus and species: ~~42~~ Blue Mussel

Clam Tag No.	Species	Width (mm)	Whole Organism Weight (g)	Time	Abnormalities	Composite No.	Notes
		65 56	[illegible]				
		71 64	[illegible]				
		74 58					
		58 56					
		62 58					
		47 72					
		61 55					
		51 54					
		52 66					
		56 63					
		72 44					
		66 52					
		67 ~~80~~48					
		61 52					
		72 54					
		~~7~~62 55					
		54 72					
		52					
		70					
		69					
		71					
		~~7~~63					
		52					
		62					
		66					

Sample Containers:

Analyses: Tissue chem

Notes: Mussels divided into 5 reps of 30 g ea

Surface Sediment Collection Log

Job: Skagway sediment investigation | Station: SED17-27
Job No: ~~1405529/7000~~ 1657831 | Date: 5 MAY 17
Field Staff: GM / PM | Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): 13.3 ft @ 11:30am
WP 495 on setting 59° 28.792
135° 20.954

Notes:
about 50m from shore after a high tide

Tide Measurements
Time: —
Height: —

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

AUS + C/T

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	11:30	59° 28.793 (WP495)	135° 20.957	Y	11cm	13.2 ft → surface intact, overlying water, good seal
2	11:40	59° 28.794 (WP496)	135° 20.958	Y	8.5cm	10.8 ft → surface intact, overlying water, good seal
3	11:50	59° 28.794 (WP497)	135° 20.959	Y	8.0	10.6 ft → good seal, overlying water, surface intact

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

grab 1 → coarse sand with fine sand, brown, a few mussel shells, fine sand and silt make up the top 1cm, a few pieces of small gravel
grab 2 → similar composition as grab 1
grab 3 → slightly smaller grab so obtained less coarse sand, otherwise similar, thin layer of shredded twigs and organics on the surface of the grab

Sample Depth:

Sample Containers:

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation | Station: SED 17 - 15

Job No: ~~1405529/7000~~ 1655271 | Date: 5MAY17

Field Staff: JM / PM | Sample Method: Van veen

Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (~~m~~): 51.6 ft @ 9:30 am

Tide Measurements

Time: —

Height: —

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: WP 488 59° 26.967 135° 19.585

~ 5-10m from pressure treated wood off of broadway dock (bumper) all ~~[illegible]~~ piles in the area are steel

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	9:30	59° 26.968 (WP489)	135° 19.586	Y	5cm	52.5 ft -> surface intact, overlying water, good seal
2	9:45	59° 26.971 (WP490)	135° 19.579	Y	5cm	53.0 ft -> surface intact, overlying water, good grab and seal
3	9:55	59° 26.969 (WP491)	135° 19.577	Y	5cm	52.4 ft -> fulfills grab requirements
4	10:00	59° 26.971 (WP ~~[illegible]~~ 492)	135° 19.580	Y	10cm	57.3 ft -> ~~[illegible]~~ surface intact, overlying water, good ~~[illegible]~~ on grab requirements

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

grab 1 -> mussels kept van veen from closing, discarded grab 2 -> usable grab 3 -> small rainbow sheen, no odour, ~~[illegible]~~ worm casings, squid observed (small crustaceans), some broken shells on surface, sm. amount of gravel and cobble ~~[illegible]~~ 4cm brown coarse sand w/ silt then grey (dark) coarse sand with silt, very loose substrate grab 4 (2nd successful) -> ~1cm of brown coarse sand and silt on top of black coarse sand and silt with little mottled bits of clay no odour no sheen broken shells grab 5 (3rd successful) -> similar constituents to other grabs grab 6 (4th successful) slight shift but ~2 or 3 m and sediment is quite different loose brown silt w/ sand on upper 1cm with underlayer composed of dark grey to metallic black silt with clay (loose), sediment smells of H_2S more here at this location than other grabs, mussel shells

Sample Depth:

Sample Containers:

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation	Station: SED17 - 10
Job No: ~~1405529/7000~~ 1657231	Date: 4MAY17 & 5MAY17
Field Staff: JM / PM	Sample Method: Van veen
Contractor: Golder Associates Ltd	

Water Height

DTM Depth Sounder (~~m~~): 46.9ft at 12:40 pm

Tide Measurements

Time: /

Height: /

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Arrived at SED17-10 → WP464 N59° 27.007 W 135° 19.586

Notes: Adjusted after 5 consecutive failed grabs → N59° 27.010 W135° 19.586 WP465 adjusted again after 2 more grabs WP467

Returned 5MAY17 at WP486 for additional sampling

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	8:30	59° 27.024	135° 19.570	Y	6cm	53.2ft → good seal surface intact, overlying water
2	8:45	59° 27.022	135° 19.569	Y	7cm	53.4 ft → good seal surface intact, overlying water
3	9:00	59° 27.019 WP487	135° 19.571	Y	6 cm	53.7 ft → good seal surface intact, overlying water

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

3 grab attempts → all failed → rocks 4th grab → also rocks 5th → rocks 2 more failed grabs so adjusted again 2 more failed grabs, 2 more failed grabs

Abandoned location and returned 5MAY17

grab 1 → thin layer of org, evidence of worms ~1cm of coarse sand with silt on top of olive grey sand w/ silt (dense), moist

Sample Depth:

grab 2 → small droplets of sheen, ~~[illegible]~~ no odour, similar constituents as grab 1

Sample Containers:

grab 3 → similar constituents as grab 1

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation | Station: SED17-29
Job No: ~~1405529/7000~~ 1657231 | Date: 4MAY17
Field Staff: SM / PAY | Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (~~m~~ ft): 52.6 at 5:05pm

Tide Measurements
Time: /
Height: /

Notes: arrived and stabilized at $\boxed{\text{WP480}}$ N 59°28.627 W135°20.148

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

AUST clean/tox
Clea + tox

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	5:05 pm	59°28.627	135°20.148	Y	18.5 cm	53.4ft → perfect grab
2	5:15 pm	59°28.628	135°20.146	Y	13.0cm	53.0ft → perfect grab, seal, water, intact
3	5:25 pm	59°28.626 (WP481)	135°20.145	Y	15.0cm	53.6ft → perfect grab

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

grab 1 → ~1cm of loose, moist silt on top of dense dark grey silty clay, very plastic, H_2S odour, dense, some decomposing organics (needles, leaves, twigs)! disposed grab 2 → thin layer of shredded organics (leaves, twigs, etc) on top of 1cm layer of loose brown silt on top of grey-black clay-y silt, decomposing odour, a few shells grab 3 → similar to grab 2

Sample Depth:

Sample Containers:

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation	Station: SED17-03
Job No: ~~1405529/7000~~ 1657231	Date: 4 MAY 17
Field Staff: SM/PM	Sample Method: Van veen
Contractor: Golder Associates Ltd	

Water Height

DTM Depth Sounder (~~m~~ ft): 9.5 @ 3:15

Tide Measurements

Time: —

Height: —

Sample Acceptability Criteria:

1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:

arrived at WP473 -> as close as what can get (low tide and deep)

lots of cobble, many repeated grabs, site deeper than intertidal areas

	Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
AVS + C/T	1	3:35	59°26.959 (WP474)	135°19.861	Y	5cm	11ft -> jaws closed, good seal, overlying water, surface entirely intact
C/T	2	3:54	59°26.958 (WP475)	135°19.863	Y	10cm	10.0ft -> jaws closed completely, good seal, overlying water
C/T	3	4:00	Same as grab	2	Y	4cm	10.9ft -> good grab, lots of cobble

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

2 unsuccessful grabs then other 2 unsuccessful grabs, then other 2 unsuccessful grabs for 7th Grab (1st successful grab) -> a few small shrimp, leaves, filamentous algae, coarse sand with silt, gravel dispersed throughout, a few mussels, silt and sand are olive brown. No odor, no sheen. 3 more unsuccessful grabs 11th grab (2nd successful) -> mix of coarse sand, grey silt, clayey silt (black-grey) 12th grab (3rd successful) similar in composition to other 2 successful grabs

Sample Depth:

Sample Containers:

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation — Station: SED 17-01
Job No: 1405529/7000 — Date: 4/14/17
Field Staff: JM / PW — Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): 47.9 @ 2 pm

Tide Measurements
Time: /
Height: /

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:
Settled at WP468, farther out and depth drops right off to ~ 100ft, steep grade N 59°26.923 W135°19.633

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	2:10	59°26.923 (WP469)	135°19.637	Y	4cm	48.3 ft -> Jaws closed, intact, overlying water.
2	2:20	59°26.923 (WP470)	135°19.636	Y	5cm	47.7 ft -> low yield but jaws closed, good grab surface intact
3	2:25	59°26.922 (WP470 as well)	135°19.634	Y	6cm	49.8 - low yield but intact and sealed grab
4	2:35	59°26.923 (WP471)	135°19.633	Y	7cm	49.6 ft -> surface intact, overlying water
5	2:40	59°26.923 (WP472)	135°19.635	Y	7cm	47.4 -> surface intact, good seal on grab, overlying water

AVS Chem Chem Chem Chem

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

1st grab -> rocks 2nd grab (1st successful) -> a few pieces of small cobble, thin (~2mm) layer of brown silt on mix of fine silt and coarse sand, no sheen, no biota, no odour. 3rd grab - rock, nothing 4th (2nd successful) -> similar horizons and composition as 1st successful grab | 5th (3rd successful) -> same as 2nd successful -> no visible biota, same composition and strata 6th (4th successful) -> loose silt w/ coarse clay (brown) ~2cm on grey clay w/ silt (firm & plastic) 7th grab (5th successful) -> surface intact -> similar to the 4th successful grab -> evidence of worms, mottled nearly black pieces of clay in grey clay underlayer

Sample Depth:

Sample Containers:

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation — Station: SED17-12
Job No: ~~1405529/7000~~ 1657231 — Date: 4MAY17
Field Staff: SM/PM — Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): 50ft @ 10:54 am

Tide Measurements
Time: —
Height: —

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:
WP458 over van veen on initial placement
N 59° 27.012 W135° 19.633
DUP-3 collected

AVS [grabs 1–2]; chem for [grabs 2–3]; DUP-3 AVS-2 [grab 4]

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	11:05	59°27 ~~°~~ .012 (WP 459)	135° 19.634	Y	4cm	48.6ft -> small grab, intact surface w/ overlying water
2	11:15	59° 27.012 (WP460)	135° 19.634	Y	5cm	49.2 ft -> small grab but intact surface and overlying water
3	11:35	59°27.013 (WP461)	135° 19.633	Y	7cm	48ft -> intact grab but minor washing at jaws, surface appears to be intact
4	11:45	59° 27.014 (WP 462)	135°19.634	Y	7.5cm	47.5ft -> intact grab, overlying water; intact surface

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 -> large sheen in sample brown silt w/ coarse sand, lots of cobble, mussels and snails, no visible clay, detectable odour
Grab 2 -> no visible sheen, similar constituents as grab 1, small amount (0.5cm) of OM on surface of grab. Grab 3 -> rocks -> nothing. Grab 4 (3rd successful) -> surface intact but mix of pieces of clay and (grey) coarse sand, and silt (both brown). Minor odour and patch of sheen after scooping

Sample Depth: for one homogenized sample, lots of shells w/ live mussels as well.
Grab 6 (4th successful) -> loose silt w/ coarse sand (brown) on

Sample Containers: upper 4cm, gravel as well, then grey silty clay (more compact) underneath, no biota, no sheen, no odour

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation	Station: SED 17-07
Job No: ~~1405529/7000~~ 1657231	Date: 4 MAY 17
Field Staff: SM / DW	Sample Method: Van veen
Contractor: Golder Associates Ltd	

Water Height

DTM Depth Sounder (m): 55.8 ft @ 8:30 am

Tide Measurements

Time:

Height: ______

Sample Acceptability Criteria:

1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: WP452 after settling → mid ore dock area

N 59° 27.002 W135° 19.622 readjusted after 4 unsuccessful grabs to WP453

Moved again to WP455

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	9:05	59° 27.004 (WP454)	135° 19.623	Y	4cm	55.7 ft → closed jaws, good seal, surface intact
2	9:30	59° 27.004 (WP455)	135° 19.622	Y	2cm	55.2 ft → close jaws, good seal, surface intact
3	9:35	59° 27.006 (WP456)	135° 19.620	Y	5cm	54.6 ft → good seal brown clay fraction, surface intact, cobble making it hard
4	9:45	59° 27.006	135° 19.620	Y	3cm	54.3 ft → good seal but mostly cobble and gravel
5	9:55	59° 27.005 (WP457)	135° 19.621	Y	4cm	55.3 ft → good seal, surface intact, overlying water

Left margin: loose / Clam; Clam + tiff

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

1st grab → rock 2nd grab → many large rocks ~20 cobble 10-20 cm in size → can't use grab 3rd grab → rocks ~10 cobble 4 grab 4 → nothing grab 5 (1st successful) → a few pieces of lg cobble coarse sand and some silt, brown and loose on top of grey clay - silt next grab: rock (6) grab 7 → 1/2 volume yield, lots of cobble, some sand (coarse) brown (2nd successful) grab 8 (3rd successful) → cobble on sand with ~3cm of silt underneath, grab 9 → nothing → rocks grab 10 (4th successful) → abundant cobble and gravel mixed together w/ some fines & sand

Sample Depth:

Sample Containers: grab 11 (5th successful) → cobble on top of coarse sand ~2cm on silt w/ clay (grey) (brown)

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation | Station: SED17-28
Job No: ~~1405529/7000~~ 1657231 | Date: 2MAY17
Field Staff: Jul / Pay | Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): 61.5ft @ 4:20

Tide Measurements
Time: /
Height: /

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: Mouth of Dyea River WP428 on flat ~~of~~ shelf of mouth

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	4:20	59° 28.593	135° 20.994	Y	8cm	59.1ft -> good seal, good grab
2	4:40	59° 28.594 ~~[illegible]~~ WP429	135° ~~[illegible]~~ 21.000	Y	3cm	60.1ft -> good seal but low yield (outside grab?)
3	4:50	59° 28.594 (WP430)	135° 20.995	Y	7cm	61.1ft
4	5:05	59° 28.595 (WP431)	135° 21.002		11.5cm	60.5ft

4:20 clean top

Clean tray

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 -> Brown silty sand with grey mottled clay throughout,
~~&~~ mixed grab Creek mixture
grab 2 -> green algae and macrophytes on surface layer
~~olive grey~~ olive brown sand
grab 3 -> olive brown sand, small shredded pieces of OM

Sample Depth: didn't collect benthic -> window broke

Sample Containers:

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation | Station: SEDI7-24
Job No: ~~1405529/7000~~ 1657231 | Date: 24/14/17
Field Staff: PM / JM | Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): 72.0ft at 2pm

Tide Measurements
Time: —
Height: —

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:
off of Dyea point on shelf before drop-off N-NW wind

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	2:00 pm	59°27.651 (WP422)	135°20.940	Y	5.5cm	Small sample but intact 72.0ft and good grab, overlying water
2	2:05 pm	59°27.652 (WP423)	135°20.941	Y	8-9cm	72.5 → small sample, angle cut but intact surface
3	2:10 pm	59°27.649 (WP424)	135°20.950	Y	6cm	72.1 → slight angl grab but good amount of overlying water and seal
4	2:20pm	59°27.650 (WP425)	135°20.945	Y	7.5cm	72.6ft → good seal, good grab
5	2:40 pm	59°27.650	135°20.935	Y	6.5cm	73.3ft → good seal, on broken surface, shells
6	3:15 pm	59°27.650 (WP426)	135°20.948	Y	6cm	75.6ft → good seal, surface intact
7	4:00pm	59°27.651 (WP427)	135°20.939	Y	6.5cm	77.5ft → good seal but low yield

Margin notes: 1st composite [1]; clean [2]; clean [3]; clean [4]; cartridge rep1 [5]; rep2 [6]; rep3 [7]

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 → sed is ~~silt~~ largely silty w/ an ~~#~~ amount of clay brown w/ mottled grey clay, broken shells
Grab 2 → hermit crab, lots of broken shells, homogenous ~~brown~~ olive-brown sed
grab 3/4 same as 2
grab 5 → hermit crab lots of shells, few organics, same sed as others
→ 2 missed grabs from boat movement
grab 6 → homogenous brown silt w/ clay, broken shells

~~Sample Depth:~~ grab 7 → sand & lg rock (~10cm), broken shells, similar grain comp as other grabs, low yield from splaying on rock, rock is sample ups

~~Sample Containers:~~ scraped for benthics

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation — Station: SED 17-18
Job No: ~~1405529/7000~~ 1657231 — Date: 24AY17
Field Staff: SM / PM — Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): 40.9 ft @ 11 am

Tide Measurements
Time: /
Height: /

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:
site located ~ 15 m from PULLEN (sp) CR out let and ~ 10 m from Broadway dock, set archor and holding steady at N 59° 27.071 and W135° 19.397
WP418

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	11:20	59° 27.071	135° 19.402	Y	19cm	39.3 ft → good sample fulfills requirements
2	11:35	59° 27.070	135° 19.403	Y	6cm	39.5 ft → good seal but fell on retrieval, smaller sample but intact and enough for chem + tox
3 (miss) 4.	11:45	59° 27.071 (WP419)	135° 19.397	Y	10cm	37.5 ft → good seal, good sample
5	12:10	59° 27. ~~[illegible]~~ 068 (WP420)	135° 19.403	Y	10cm	38.1 ft → perfect grab
6	12:45	59° 27.068	135° 19.395	Y	6cm	18.5 → small grab but in tact - was batting w/ blade so couldn't glue thumbs down
7	12:55	59° 27.070	135° 19.392	Y	12.5cm	→ perfect grab 30 ft

Left margin: AVS + chem + tox [grab 1]; Chem + tox [grab 2]; Chem + tox [grab 4]; F1 Benthic F2 Compo F3 [grabs 5–7]

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 → loose ~~[illegible]~~ brown silt at (~1cm) with small amount of oil on top, a few worms, live mussels, underneath this layer was light and dark grey clay-y silt, almost metallic, a few aquatic macro phytes and old shredded wood
Grab 2 → small grab of mixed (angle cut) of grey silt and brown silt, a few mussels and worms visible. Grab 4 → lots of organics, leaves on surface, same horizons as grab 1 grey silt has shredded rotting wood and small twigs

~~Sample Depth:~~
grab 5 → worms, mussels, similar composition

Sample Containers: grab 6 → disturbed sed. → similar composition to grab 4
grab 7 → lots of shells, ~~an~~ eel, some ~~[illegible]~~ ~~[illegible]~~ on surface

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation | Station: SED17-18
Job No: ~~1405529/7000~~ 1657231 | Date: 2 MAY 17
Field Staff: SM/ PM | Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): 46.9 ft at anchor at 8:50 am

Tide Measurements
Time: —
Height: —

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:
trying double anchor to swaying little in the wave / current
DUP-2 collected

	Grab #	Time	NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
AVS + chem + tox	1	8:55	59° 27.093 (WP412)	135° 19.489	Y	14cm	46.8 ft → good seal, overlying water but sed looks slightly disturbed
chem + tox	2	9:09	59° 27.093 (WP 413)	135° 19.487	Y	9cm	44.4 ft → good seal very slow descent overlying water
	3	9:25	59° 27.091 (WP 414)	135° 19.489	Y	9cm	45.7 → good seal, overlying water undisturbed
benth r.1	4	9:45	59° 27.094 (WP415)	135° 19.490	Y	10cm	42.9 → good seal undisturbed overlying water
benth r2	5	10:05	59° 27.093 (WP416)	135° 19.492	Y	13cm on slight angle	42.1 ft → good seal good grab
benth r.3	6	10:25	59° 27.091 (WP417)	135° 19.493	Y	~~13cm~~ 14cm	41.9 ft → good seal good grab

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 → live mussels 1 than 0.5 cm brown silt on top of black loose clayey silt w/ humic odour, no sheen
Grab 2 → 2 mussels, evidence of worms 0.5 cm brown silt on light grey and nearly black grey silt w/ clay (loose)
Grab 3 → similar to grab 2, lg. pieces of squared rotten wood
Grab 4 → brown silt (loose) on top (~1 cm) of red tube, mottles (large) of

Sample Depth: light and metallic grey silt w/ clay (loose)
Grab 5 - same as 4 but w/ sticks and rootlets, a few mussels

Sample Containers: Grab 6 → 1 cm of brown silt on (loose) same sub-strata and horizons as other grabs

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation
Station: SED17-20

Job No: ~~1405529/7000~~ 1657231
Date: 1 MAY 17

Field Staff: JM / PM
Sample Method: Van veen

Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (~~m~~): 47.5 Ft @ 3:50 pm

Notes: WP408 at arrival N 59° 26.827 W135° 19.343
roped to pile

Tide Measurements

Time: /

Height: /

Sample Acceptability Criteria:

1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

	Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc	
NVS + clean / top clean	1	4:00	–	–	y	8.5	jaws closed, good seal overlying water, but evidence of turbulence	49.2 ft. in good
	2	4:20	–	–	y	16cm	49.5 ft - jaws closed, good seal	
clean	3	4:30	–	–	y	12cm	50.1ft -> jaws closed overlying water but sediment layers disturbed	
	4.	4:45				19	~50ft	
	5	5:00				13	~50ft	
	6	5:05				15	~50ft	

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 -> 1 cm of brown silt on grey ~~to~~ metallic grey loose clay, many many mussels on top of grab -> alive a few patches of rusty coloured sediment Grab 2 -> same horizons as grab 1 lots of woody debris, live mussels, barnacles Grab 3 -> mussels & wood, same horizons as other samples

Sample Depth:

Sample Containers:

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation	Station: SED17-21
Job No: ~~1405529/7000~~ 1657831	Date: 7 MAY 17
Field Staff: JM / PM	Sample Method: Van veen
Contractor: Golder Associates Ltd	

Water Height

DTM Depth Sounder (m): 60.5 at 1:30 pm

Tide Measurements

Time: /

Height: /

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:

Tied to piles so little movement $\boxed{WP404}$ N59°26.760 W135°19.473

Readjusted to N59°26.767 W135°19.455 $\boxed{WP405}$

Readjusted again to $\boxed{WP406}$ then to $\boxed{WP407}$

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	2:11 pm	(WP405)	—	Y	5cm - 0cm (Couple bite)	57.7ft → good seal, surface intact, similar to 3 other seal along dock
~~2~~	2:45 pm					
~~3~~ 2	2:45 pm	(WP406) 59°26.770	135°19.454	Y	6cm → 0cm (Couple bite)	60.6ft → good seal, surface intact,
3	3:30 pm	(WP407) 59°26.768	135°19.450	Y	6cm	61.3ft → good seal low yield

Abs + clean tox

clean + tox

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 2 → missed → 5 missed before a workable sample Grab 1 → 1cm brown sed (silt) on grey a loose clay, broken shells no odour, no biota, no sheen

Grab 2 is similar to 1st grab 4 more grabs with less than 50% + 1 grab → miss

Grab 3 → similar to others

~~Sample Depth~~: not enough for all tox but grab abandoned location as moved on.

~~Sample Containers~~:

~~Analyses~~:

Surface Sediment Collection Log

Job: Skagway sediment investigation | Station: SED17-22
Job No: ~~14055297000~~ 1657231 | Date: 4 May 17
Field Staff: Sam / Pdq | Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): 88ft on arrival at ~9:50am

Tide Measurements
Time:
Height:

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:
WP401 or N59° 26.659 W135°19.648 -> slip tied to wooden bumpers so fairly stationary, Readjusted to WP402

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	10:00	/	/	Y	5cm	88ft -> good seal but disturbed seal ->
2	10:15			Y	6cm	78ft -> good seal, overlying water
3	10:50	(WP402) N59° 26.675	W135.19.620	Y	9cm	81ft -> good seal and undisturbed sed
4	11:20	/	/	Y	10cm	78.6ft -> good seal surface flat,
5	11:40	/	/	Y	6cm	80ft -> good seal, surface intact
6	12:10			Y	6cm	81ft -> good seal, surface intact
7	12:25	/	/	Y	9.5cm	83.5ft -> good seal, overlying water
		End -> WP403	59°26.675	135°19.624		

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 -> large blocks of grey clay ~~with~~ dense and plastic ~~~~ under 1cm of loose brown silt
Grab 2 -> Same as 1 -> some cobble and small shells
Grab 3 -> Small cobble & shells ~~under~~ mixed with 2cm of a loose wet silt (light brown) on top of more dense grey clay grab 4 some shells same composition as grab 3 grab 5 silt and clay 1cm brown on grey, lots

Sample Depth: of worms and shells' grab 6 same as grab 5

Sample Containers: Grab 6 & 7 are similar -> mostly silty clay - lots of shells, organics, worms & ~~~~ some cobble 1-4cm in size 1cm of brown silt

Analyses: on grey ~~~~ clay, moldable w/ finger

Surface Sediment Collection Log

Job: Skagway sediment investigation | Station: SED17-17

Job No: ~~1405529/7000~~ 1657231 | Date: 30 APR17

Field Staff: SM / PM | Sample Method: Van veen

Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): 53.3 ft @ 4:15 pm

Tide Measurements

Time: /

Height: /

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: Initially set at WP390 59°27.43 135°19.471

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	4:20 pm	59°27.043 (WP391)	135°19.471	Y	6.5 cm	48.4 ft → good seal on van veen, surface intact, overlying water
2	4:30 pm	59°27.043 (WP392)	135°19.471	Y	6 cm	53.1 ft → good seal on van veen but hit sediment slightly cracked, surface ok
3	4:45 pm	59°27.041 (WP393)	135°19.484	Y	9 cm	53.6 ft → good seal w/ overlying water, intact surface
4	5 pm	59°27.043 (WP394)	135°19.491	Y	7 cm	53.4 ft → good seal w/ overlying water, intact surface
5	5:25 pm	59°27.040 (WP395)	135°19.484	Y	6 cm	54.7 ft → good seal w/ overlying water, intact surface but low yield
6	5:35 pm	59°27.045 (WP396)	135°19.491	Y	6 cm	54.9 ft → good seal, some disturbance on surface but assumed to be from heavy wave action
7	5:50 pm	/ (WP397) → moved a little bit (lifting anchor)	/	Y - likely	more like WP396	— → moved before measurement

Margin notes: AWS + clean; clean; benth r.1; r2; r3

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 → 1 cm of brown silt w/ sand on (loose) on dense grey silt w/ clay → moist & firm. Grab 2 → similar to grab 1 → no biota, sheen or odour. Grab 3 → similar composition of sediment as other grabs but contained a few mussels, a few cobble-sized rocks and some aquatic macrophytes. Grab 4 → 1 cm of silt (brown & loose) on denser silt w/ clay (grey). flecks of rust throughout grey silt, mussels and worms also in grey silt. Grab 5 → similar

Sample Depth: composition as grab 1, small fleck in benthic bucket, aqu. worms, pieces of shell. grab 6 → shells and worms, same comp as grab 1. grab 7 →

Sample Containers: 1 cm of loose sed (brown) then rest is grey silt → even evidence of worms & some crushed shells visible

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation — Station: SED17-14
Job No: ~~1405529/7000~~ 1657231 — Date: 30APR17
Field Staff: SM / PM — Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): 38.9ft @ 9:50

Tide Measurements
Time: /
Height: /

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:
Approaching slack tide so some movement after anchor is placed (v. low wind)
WP371 59°27.019 135°19.169 on initial set
Returned in the afternoon at WP383 59°27.031 135°19.591

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	2:45 pm	59°27.030 (WP384)	135°19.584	Y	5cm	52 ft → v. small grab but surface is intact
2	2:55 pm	59°27.032 (WP385)	135°19.589	Y	6 cm	52 ft → surface intact → lots of standing water
3	3:05 pm	59°27.029 (WP386)	135°19.587	Y	0cm on one side 6.5cm on other	52.4 ft → surface intact but sed sampled on angle
4	3:10 pm	59°27.030 (WP387)	135°19.591	Y	7cm	52.8 ft → surface intact with overlying water → good seal
6	3:30 pm	59°27.030 (WP388)	135°19.598	Y	6cm	53.4 ft → surface intact overlying water, good seal
7	3:50 pm	59°27.030 (WP389)	135°19.599	Y	6.5	54.4 ft → surface intact overlying water grab was square in the water
8.	4:00 pm	same as grab 7	—	Y		

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 → 1mm of reddish OM (worms) on top of brown loose silt on coarse sand w/ 4-10cm cobble, worms (cm long) also caught a small crab
Grab 2 → same as 1 Grab 3 → 1cm of brown (light) silt w/ some fine organics over top of grey green coarse sand w/ silty fines, top layer is loose, bottom layer is compact and dense Grab 4 → a few pieces of cobble, a few chunks of mussels, same top layer as other samples & small amounts of sheen in homogenized sample

Sample Depth: grab 5 → mislike grab 6 → stratified sample, brown sed on top

Sample Containers:

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation — Station: GED17-11

Job No: ~~1405529/7000~~ 1657231 — Date: 30APR17

Field Staff: JM/PM — Sample Method: Van veen

Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): 39.5 ft @ 10:45 am

Tide Measurements

Time: using skagway station

Height: ____

Sample Acceptability Criteria:

1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: $\boxed{\text{WP373}}$ 59° 27.011 135° 19.614 at onset of sampling

▼

just clean / clean

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
2	10:45 am	59° ~~27~~ .013 (WP374)	135° 19.619	Y	4cm	39.0ft -> low yield but intact
4	10:05 am	59° 27.012 (WP375)	135° 19.614	Y	6cm	39.5ft -> low yield but intact
5	11:15 am	59° 27.011 (WP376)	135° 19.615	Y	7cm	39.8ft -> low yield but intact
7	11:20 am	59° 27.011 (WP377)	135° 19.614	Y	4cm	39.3ft -> low yield but intact
12	12:00 pm	59° 27.011 (WP378)	135° 19.614	Y	7cm	41ft -> low yield due to choppy water and rocks intact
13	12:10 pm	59° 27.011 (WP379)	135° 19.611	Y	6-10cm (angular cut)	
14	12:25 pm	59° 27.014 (WP380)	135° 19.612	Y	5cm	42ft -> lots of cobble but grab was intact
15	12:55 pm	59° 27.014	135° 19.614	Y	6.5cm	44ft -> surface was intact -> lots of cobble
17	1:15 pm	59° 27.014 (WP381)	135° 19.611	Y	4.5cm	45ft -> intact lots of cobble
19	1:35 pm	59° 27.014 (WP382)	135° 19.612	Y	5cm	46ft -> intact

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 -> rock -> can't use grab 3 -> rocks w/ grab 2 -> sand w/ silt [illegible], used layer of reddish [illegible] on top of sed [illegible] organics, moist, some amounts of clay (can roll sed in fingers), consolidated, few lg (3-10cm) rocks
Grab 4 - small grab -> rocks aggregate and [illegible] silt on hard packed sand [illegible] brown in colour. Grab 5 -> same as above -> no biota, sheen or odour grab 6 -> nothing -> rocks grab 7 -> similar composition as grab 5 grab 8 -> nothing -> rock grab 9 -> gravel

Sample Depth: can't use grab 10 -> nothing -> no rocks (misfire?) grab 11 -> nothing -> rocks
grab 12 -> 1cm of [illegible] silt on coarse sand w/ cobble interspersed

Sample Containers: no biota, sheen or odour grab 13 -> angular cut grab 14 -> same grab 15 -> rock
grab 16 -> same -> rock grab -> cobble stuck in van veen teeth but surface intact.

Analyses: grab 17 -> small cobble in teeth but surface intact -> visible particles, no sheen
grab 18 -> nothing -> rocks grab 19 -> cobble under silt and coarse sand

Surface Sediment Collection Log

Job: Skagway sediment investigation
Station: SED 17-B
Job No: ~~1405529/7000~~ 1657831
Date: 29 APR 17
Field Staff: SM / PM
Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m):______

Tide Measurements

Time:

Height: ______

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:
Parked w/ slipline at WP365

AUS Chem / Chem / Benthics

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
2	2:25	59°27.017 WP365	135°19.640	Y	14cm	50ft - intact successful grab
3	2:45	-	-	Y	11cm	50ft - intact successful
4	3:00	-	-	Y	13cm	~50ft -> top 90% turned off -> clean grab w/ undisturbed intact surface layer
5	3:20	-	-	Y	13cm	Same as others - undisturbed top layer
6	3:45	-	-	Y	12cm	intact grab - undisturbed top layer
7	4:15	-	-	Y	17cm	-> intact grab -> similar to previous -> undisturbed top layer

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 2 -> mussels & worms, Brown sed on top 1cm reddish sed on top 1mm, v. dark almost black sed on lower, ~~[illegible]~~ fine silt w/ clay loose, soft, metallic, moist
Grab 2 -> worms -> mussels Grab 3 -> same as Grab 2 -> top worms, thin layer of brown sed on metallic grey sed Grab 4 -> same as grab 2 ALL GRABS -> No sheen, No smell, sed sticks to everything Grab 5 -> same as others -> sheen visible in benthic community sample after formalin was added. Sediment

Sample Depth: gets on everything Grab 6 - lots of mussels -> similar to others, worms, small shiny flecks in sediment, yellowish in colour, sheen visible

Sample Containers: [illegible] benthic [illegible] Grab 7 ->

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation | Station: SED17-09
Job No: ~~1405529/7000~~ 1657231 | Date: 24 APR 17
Field Staff: SMC PM | Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): ?

Notes: WP366 GPS = 59° 27.021 / 135° 19.652 > as tied off against pilings so gps points for remaining samples

Tide Measurements

Time: 5 pm

Height: N/A

Sample Acceptability Criteria:

1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

sounder is picking up piling so no reading for depth

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	5:15	—	—	Y	13cm	? depth - intact grab,
2	5:35	—	—	Y	12cm	? depth - intact
3	5:45	—	—	Y	12cm	? depth - intact
4	6:10	—	—	Y	13cm	? depth - intact
5	6:35	—	—	Y	12cm	? depth - intact
6	6:55	—	—	Y	15cm	? depth - intact, wall sed sample

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 - 1cm of brown sed. under 1mm of red-purple oil and under metallic grey fine clayey silt, mussels present, lots of worms, no visible sheen, no odour
Grab 2 -> 1cm of brown sed. on top of ~1mm of rust colour on black metallic sed mussels, worms, small speckles of sheen throughout Grab 3 -> rust ~1mm on brown sed (~1cm) on metallic black, ~4cm of loose sed then hard, malleable sed of plasticity, speckled sheen throughout sample

Sample Depth: Grab 4 -> flecks of sheen, same composition as other samples -> lots of lots of mussels
worms present slight rotting odour Grab 5 - same as others visible worms

Sample Containers: Grab 6 -> similar to others lots of mussels, plethora of worms

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation | Station: SED17-31
Job No: ~~1405529/7000~~ 1657231 | Date: 27 Apr 17 & 28 APR 17
Field Staff: SM/PM | Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (m): ______

Tide Measurements
Time:
Height: ______

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: DUP-1 collected for chem only not for tox

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	11:00	59° 28.620 (WP 352)	135° 20.355	Y	10 cm = ~65%	→ didn't use sample
		STOOD DOWN	DUE TO WEATHER →			
2 (next day)	9:00	59° 28.626 (WP 357)	135° 20.361	Y	retained 15 cm ~70%	the next day 37.9 ft - silt w/ clay, loose intact grab
4	9:30	59° 28.626	135° 20.3855	Y	17 cm ~80%	35.6 ft → silt w/ clay intact grab
5	9:45	same	same	N	misfire	
6	10:00	59° 28.627	135° 20.356	Y	~17 cm ~80%	37.3 ft → intact grab (full)
8	11:00	59° 28.626	135° 20.364	Y	~18.5 cm	37.9 ft → intact grab
9	12:15	59° 28.628	135° 20.354	Y	~19 cm	48.2 ft → intact grab
10	12:45	59° 28.627	135° 20 355	Y	~19 cm	48.1 ft → intact grab

chem

Benthics

Benthics

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 = v. little → not used Grab 2 = silt w/ clay → loose, interspersed w/ gravel and shells, so many mussels & barnacles w/ some macrophytes, grey-green in colour, not plastic, some twigs // Next day: Grab 1 nothing → which slipped Grab 2 → large grab → grey green w/ few [illegible] rotting wood sporadic gravel (~1-2 cm) and small pieces of driftwood & worms & cracked shells, a dark grey sediment underneath light colour grab 3 → misfire, grab 4 → lots of worms, aquatic caterpillar, broken shells, worms, broken twigs, same sed as grab 2 from this day grab 6 → same as grab 2, worms, shells, mussels, twigs, grab 7 & 8 tilted the grab loss material failed → [illegible] grab 9 → similar composition as other grabs for grab 10 → same as other grabs → has barnacles on pieces of wood lots of [illegible]

~~Sample Depth:~~

~~Sample Containers:~~

~~Analyses:~~

Surface Sediment Collection Log

Job: Skagway sediment investigation | Station: SED17-06
Job No: 1405529/7000 | Date: 26 Apr 17
Field Staff: SM / PM | Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height

DTM Depth Sounder (~~m~~ FT): ______

Tide Measurements

Time:

Height: ______

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:
WP341 at centre of SED17-06 → difficult site → moved slightly

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	11:55	(WP341) 59°26.972	135°19.601	y	~7 cm	56 ft - low yield due to rocks
3	12:20	(WP342)		y	~5 cm ~30%	57 ft - low yield due to rocks
4	12:55	(WP343) 59°26.975	135°19.634	y	~0.5 cm ~10%	58.9 ft - low yield due to rocks
5	1:05	59°26.976 (WP344)	135°19.635	y	~4 cm ~35%	59 ft - low yield - fines w/ rocks
6	1:15	(WP345) 59°26.970	135°19.635	y	~4 cm ~20%	59.5 ft - low yield - no rocks just hard-packed sed
10	1:50	59°26.977 (WP346)	135°19.636	y	~3 cm ~15%	60 ft - meets sampling requirements but low yield
11	2:05	(WP347) 59°26.977	135°19.632	y	~3 cm ~15%	60 ft - low yield but intact
12	2:10	(WP348) 59°26.975	135°19.658	y	~3 cm ~15%	60 ft - low yield but intact
13	2:25	(WP349) 59°26.976	135°19.636	y	~3 cm ~15%	60.5 ft - low yield but intact
Benthic Community wasn't collected (winch issues)						
14	Returned 1:15	29 APR 17 (WP364) 59°26.977	135°19.644	y	~2.5 cm ~20%	64.9 ft - low yield but surface intact
15	1:30	59°26.977	135°19.644	y	~7 cm 10%	64 ft - low yield but surface intact
18	1:45	59°26.977	135°19.644	y	~4.5	51.5 - low yield - intact

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 - lots of rocks 2-10 cm in size, coarse sand, low amount of fines no odour/biota/sheen
Grab 2 - rocks → insufficient sample → discarded Grab 3 → low yield but included in composite for chem coarse
sand Grab 4 - sm. amount of OM on surface of sed, macrophyte biota (sm. amount), coarse sand with
some silt Grab 5 large rocks w/ fines → silt w/ some coarse sand → ~2cm of loose sed on hard
packed sed Grab 6 → silt overlaying coarse sand → grey-green in colour Grab 7 → failed → rock 8
tried freefall → failed Grab 9 freefall again → added weight [illegible] the [illegible] Grab 11 →

Sample Depth: OM ~1mm on silt w/ sand Grab 12 → OM on top ~1mm w/ silt and sand
Grab 13 → same as 11 Grab 14 → low yield but [illegible] ~1mm in OM

Sample Containers: OM on top, a few larger rocks (~4 cm), very consistent Grab 15 -
same as Grab 14 Grab 16 and 17 - missfire (rocks ... a [illegible])

Analyses: Grab 18 - same as other grabs, worms, mussels, sand w/ silt

Surface Sediment Collection Log

Job: Skagway sediment investigation	Station: SED17-08
Job No: 1405529/7000	Date: 26 APR 17
Field Staff: JW / PM	Sample Method: Van veen
Contractor: Golder Associates Ltd	

Water Height

DTM Depth Sounder (m): 39 ft at today arrival

Tide Measurements

Time:

Height: ______

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes:
arrived at low-low tide Grab 6 (benthics) seemed to have petrol chips in it
only listing successful grabs

	Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (E)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
Chem	1	8:15	59°26.993	135°19.658	Y	7.5 cm = ~40%	39 ft - surface intact thin layer of oil on brown clay, ~~red~~ petrol flecks
Chem	2	8:30	59°26.993	135°19.660	Y	9 cm = ~50	39 ft - surface intact, small shrimp, small amount of overlying water, worms
Chem	3	8:45	59°26.993 (WP332)	135°19.658	Y	9 cm = ~50%	40 ft - surface intact, worms, mussels
Chem	5	9:15	59°26.996 (WP333)	135°19.641	Y	= 8 cm = ~45%	44 ft = surface intact, worms, mussels
Benthics	6	9:55	~~59~~ 59°26.993 (WP374)	135°19.658	Y	= 8 cm = ~45%	45 ft - surface intact, worms, good for benths, small balls of clay ~ golf ball size
Benthics	8	10:15	59°26.999 (WP335 - rock; 336)	135°19.638	Y	= 9.5 cm ~ 50%	48.0 ft thin layer of oil on surface, good grab
Benthics	12	10:45	59°26.999 (WP337 - rock; ~~338~~ 339)	135°19.654 (WP340) - used	Y	= 7.5 = ~40%	48.5 ft -> 50.9 while sampling, sm. amount of oil on surface

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Grab 1 - Dense grey-green ~~m~~ med. sand w/ silt some small broken shells, mussels and kelp, hard
Grab 2 - same as grab 1
Grab 3 - Hard packed coarse sand ~~w~~ with silt, grey-green, no odour, no sheen
Grab 4 - sample fell at an angle surface not intact. Grab 5 - fishy smell, seal same as 1 appears to be 2 types of sediment coarse sand and fine loose silt, mostly they are mixed but sometimes they are separated grab 7 = rock can't use, grab 8: full grab fine sand with

Sample Depth: ~~tide~~ clay -> dark green, plastic, no visible biota grab ~~8~~ 9 - rock can't use grab 10 - low yield - not using grab 11 - rock grab 12

Sample Containers: Grab 12 -> c. coarse sand w/ silt, small golf ball sized pieces of clay, shells (broken)

Analyses:

Surface Sediment Collection Log

Job: Skagway sediment investigation — Station: SED17-05
Job No: ~~1405529/7000~~ 1657231 — Date: 25 Apr 17
Field Staff: JM / RM — Sample Method: Van veen
Contractor: Golder Associates Ltd

Water Height
DTM Depth Sounder (m): 48.0
59° 26.957 N
Notes: 135° 17.706 W

secured with anchor

Tide Measurements
Time: 9:45 am
Height: ______

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Grab #	Time	Confirmed Coordinates (datum) NAD 83 (N)	NAD 83 (W)	Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
1	9:30 am	59°26.957 N 135°17.706 W	—	N	—	issues with winch
2	10:40 am	59° 26.449 59° 26.952	135°19.719 135° 19.706	Y	~8cm	52 ft depth, old rusty bolt [illegible] in sample [illegible]
3	11:15	(WP 324) ~~080~~ 0981376	6590135	Y	~9cm 60%	54.0 ft depth, surface intact
4/5	11:35 11:55	59°26.957 "	135° 19.714 "	N/N	~9cm ~40% ~30%	56 ft - small amount of sheen 57 ft
6	~~12:00~~ 1:00	59° 26.955 (WP 324)	135° 19.701	Y	~8cm ~40%	60 ft -> sm. mussels ~5mm of red oil on surface
7	2:30	59° 26.966	135° 19.690	Y	~6cm ~40%	59.1 ft - w/ mussels 1mm of [illegible]
8/9	3:00 4:00	59° 26.966 59° 26.954	135° 19.690 135° 19.710	Y/Y	~6cm ~40% ~10cm	59.1 ft 52.0 ft - surface undisturbed

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

grab 2: small molluscs, solid, dense sand with silt, old shells -> no sheen [illegible]
grab 3: small molluscs, solid, plastic, -> same as grab 2 [illegible] oil on surface
grab 5: tried locations, [illegible] but no recovery LOS [illegible]
grab 6: same
grab 7: snails, mussels, sm. ad. macrophytes -> same substrate as other samples (Benthic)
8&9

Sample Depth: —

Sample Containers: —

Analyses: —

APPENDIX D

Sediment and Tissue Analytical Reports

ALS Environmental
ALS Group USA, Corp
1317 South 13th Avenue
Kelso, WA 98626
T : +1 360 577 7222
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www.alsglobal.com

May 05, 2017

Analytical Report for Service Request No: K1704246

Tamra Reynolds
Golder Associates Ltd.
Suite 201C, 170 Titanium Way
Whitehorse, YT Y1A0G1

RE: Skagway-Sediment 2017 / 1657231

Dear Tamra,

Enclosed are the results of the sample(s) submitted to our laboratory April 29, 2017
For your reference, these analyses have been assigned our service request number **K1704246.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3364. You may also contact me via email at howard.holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Howard Holmes
Project Manager

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Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- E The result is an estimate amount because the value exceeded the instrument calibration range.
- J The result is an estimated value.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.
- H The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

- # The control limit criteria is not applicable. See case narrative.
- J The result is an estimated value.
- E The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
- M The duplicate injection precision was not met.
- N The Matrix Spike sample recovery is not within control limits. See case narrative.
- S The reported value was determined by the Method of Standard Additions (MSA).
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- W The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- + The correlation coefficient for the MSA is less than 0.995.
- Q See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- A A tentatively identified compound, a suspected aldol-condensation product.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- C The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
- D The reported result is from a dilution.
- E The result is an estimated value.
- J The result is an estimated value.
- N The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
- P The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

- F The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
- L The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
- H The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
- O The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
- Y The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
- Z The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	Not available	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	03016
Maine DHS	Not available	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
North Carolina DWQ	http://www.dwqlab.org/	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/envserv/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS Environmental—Kelso Laboratory
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ALS ENVIRONMENTAL

Client:	Golder Associates	**Service Request No.:**	K1704246
Project:	Skagway Sediments/1657231	**Date Received:**	4/29/2017
Sample Matrix:	Sediment		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), and Laboratory Control Sample (LCS).

Sample Receipt

Three sediment samples were received for analysis at ALS Environmental on 4/29/2017. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

Total Metals

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for the replicate analysis of Calcium and Silver in sample SED17-05 was outside the normal ALS control limits. The variability in the results was attributed to the heterogeneous character of the sample. Standard mixing techniques were used, but were not sufficient for complete homogenization of this sample.

Matrix Spike Recovery Exceptions:
Antimony recoveries are generally low for soil and sediment samples when digested using EPA Method 3050B. Despite anticipated low recoveries, the method is still generally prescribed because of its versatility for general metals analysis. Antimony results (in conjunction with the matrix spike recovery) from this procedure should only be used as indicators to estimate concentrations. The matrix spike recovery of Antimony for sample SED17-05 was below the ALS control criterion. Since low recoveries resulted from a method defect and were possibly magnified by certain matrix components, no corrective action was appropriate. Alternative procedures that specifically target Antimony are available but were not specified for this project. The associated QA/QC results (e.g. control sample, calibration standards, etc.) indicated the analysis was in control.

No other anomalies associated with the analysis of these samples were observed.

Polynuclear Aromatic Hydrocarbons by EPA Method 8270

Matrix Spike Recovery Exceptions:
The control criteria for matrix spike recovery of multiple analytes for sample Batch QC were not applicable. The analyte concentrations in the sample were significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

Approved by______________________________

Lab Control Sample Exceptions:
The recoveries of multiple analytes in LCS/DLCS KWG1703532-3/KWG1703532-4 were outside the control limits listed in the results summary. The limits are default values temporarily in use until sufficient data points are generated to calculate statistical control limits. Based on the method and historic data, the recoveries observed were in the range expected for this procedure. No further corrective action was taken.

No other anomalies associated with the analysis of these samples were observed.

Approved by____

Chain of Custody

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Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

K1704246

ALS Environmental
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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 - 594998

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates LTD
Contact:	Tamra Reynolds
Phone:	1-867-334-4468
	Company address below will appear on the final report
Street:	170-201CT. Ogilvie Way
City/Province:	Whitehorse, Yukon
Postal Code:	Y1A 0G1
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax TJREYNOLDS@golder.com

Email 2 PADDY_MCMANUS@golder.com

Email 3 VMERCER@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax Same as report

Email 2

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☑ 3 day [P3] ☐ 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: 41037

Job #: 1657231

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#

Major/Minor Code: | Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Payfair | Sampler: PM / SM

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals	PAHs	Grainsize (GS)	Total Organic Carbon (TOC)	DRO	AVS/SEM	Number of Containers
	SED17-05	25-Apr-17	17:00	Sediment	X	X	X	X			5
	SED17-08	26-APR-17	17:00	↓	↓	↓	↓	↓			6
	SED17-06	26-APR-17	17:00	↓	↓	↓	↓	↓			6

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Please archive unused samples. 5-day turnaround on metals and PAHs regular turn around on GS and TOC. Wait for directions for DRO : AVS/SEM

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 27-APR-17	Time: 7:00am	Received by: [signature]	Date: 4/29/17	Time: 0910	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS

PC HH

Cooler Receipt and Preservation Form

Client Golder Associates LTD. Service Request K17 04246

Received: 4/29/17 Opened: 4/29/17 By: CG Unloaded: 4/29/17 By: CG

1. Samples were received via? *USPS* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* ______ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where? 1 Front

   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
1.2	1.1	3.3	3.2	-0.1	375		027 1941 1092	✓

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* Box w/dividers
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA Y N

   If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions:

RUSH

7/25/16

Page ____ *of* ____

Total Solids

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ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/25/17 - 04/26/17
Sample Matrix:	Sediment	**Date Received:**	04/29/17
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
SED17-05	K1704246-001	**73.5**	-	1	05/01/17 17:04	
SED17-08	K1704246-002	**79.4**	-	1	05/01/17 17:04	
SED17-06	K1704246-003	**77.9**	-	1	05/01/17 17:04	

QA/QC Report

Client: Golder Associates, Inc.
Project Skagway-Sediment 2017/1657231
Sample Matrix: Solid Fuel

Service Request: K1704246
Date Collected: 04/25/17
Date Received: 04/29/17

Analysis Method: 160.3 Modified
Prep Method: None

Units: Percent
Basis: As Received

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Batch QC	K1704164-001DUP	-	52.3	55.5	53.9	6	20	05/01/17
SED17-05	K1704246-001DUP	-	73.5	74.3	73.9	1	20	05/01/17

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Metals

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/25/17 17:00
Sample Matrix:	Sediment	**Date Received:**	04/29/17 09:10
Sample Name:	SED17-05	**Basis:**	Dry
Lab Code:	K1704246-001		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**10800**		mg/Kg	2.4	2	05/03/17 12:03	05/01/17	
Antimony	6020A	ND	U	mg/Kg	0.060	5	05/03/17 08:44	05/01/17	
Arsenic	6020A	**2.03**		mg/Kg	0.60	5	05/03/17 08:44	05/01/17	
Barium	6010C	**235**		mg/Kg	0.96	2	05/03/17 12:03	05/01/17	
Beryllium	6020A	**0.197**		mg/Kg	0.024	5	05/03/17 08:44	05/01/17	
Cadmium	6020A	**0.248**		mg/Kg	0.024	5	05/03/17 08:44	05/01/17	
Calcium	6010C	**6240**		mg/Kg	4.8	2	05/03/17 12:03	05/01/17	
Chromium	6020A	**11.7**		mg/Kg	0.24	5	05/03/17 08:44	05/01/17	
Cobalt	6020A	**5.66**		mg/Kg	0.024	5	05/03/17 08:44	05/01/17	
Copper	6020A	**34.3**		mg/Kg	0.12	5	05/03/17 08:44	05/01/17	
Iron	6010C	**21500**		mg/Kg	4.8	2	05/03/17 12:03	05/01/17	
Lead	6020A	**82.6**		mg/Kg	0.060	5	05/03/17 08:44	05/01/17	
Magnesium	6010C	**7130**		mg/Kg	2.4	2	05/03/17 12:03	05/01/17	
Manganese	6010C	**286**		mg/Kg	0.24	2	05/03/17 12:03	05/01/17	
Mercury	7471B	**0.139**		mg/Kg	0.023	1	05/03/17 11:26	05/02/17	
Nickel	6020A	**6.18**		mg/Kg	0.24	5	05/03/17 08:44	05/01/17	
Potassium	6010C	**4940**		mg/Kg	48	2	05/03/17 12:03	05/01/17	
Selenium	6020A	ND	U	mg/Kg	1.2	5	05/03/17 08:55	05/01/17	
Silver	6020A	**0.287**		mg/Kg	0.024	5	05/03/17 08:44	05/01/17	
Sodium	6010C	**4740**		mg/Kg	48	2	05/03/17 12:03	05/01/17	
Thallium	6020A	**0.247**		mg/Kg	0.024	5	05/03/17 08:44	05/01/17	
Vanadium	6020A	**38.5**		mg/Kg	0.24	5	05/03/17 08:44	05/01/17	
Zinc	6010C	**171**		mg/Kg	1.2	2	05/03/17 12:03	05/01/17	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/26/17 17:00
Sample Matrix:	Sediment	**Date Received:**	04/29/17 09:10
Sample Name:	SED17-08	**Basis:**	Dry
Lab Code:	K1704246-002		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**7950**	mg/Kg	2.3	2	05/03/17 12:14	05/01/17	
Antimony	6020A	**0.120**	mg/Kg	0.057	5	05/03/17 09:05	05/01/17	
Arsenic	6020A	**3.69**	mg/Kg	0.57	5	05/03/17 09:05	05/01/17	
Barium	6010C	**187**	mg/Kg	0.91	2	05/03/17 12:14	05/01/17	
Beryllium	6020A	**0.212**	mg/Kg	0.023	5	05/03/17 09:05	05/01/17	
Cadmium	6020A	**0.325**	mg/Kg	0.023	5	05/03/17 09:05	05/01/17	
Calcium	6010C	**9760**	mg/Kg	4.5	2	05/03/17 12:14	05/01/17	
Chromium	6020A	**12.9**	mg/Kg	0.23	5	05/03/17 09:05	05/01/17	
Cobalt	6020A	**6.63**	mg/Kg	0.023	5	05/03/17 09:05	05/01/17	
Copper	6020A	**207**	mg/Kg	0.11	5	05/03/17 09:05	05/01/17	
Iron	6010C	**17700**	mg/Kg	4.5	2	05/03/17 12:14	05/01/17	
Lead	6020A	**594**	mg/Kg	0.057	5	05/03/17 09:05	05/01/17	
Magnesium	6010C	**5480**	mg/Kg	2.3	2	05/03/17 12:14	05/01/17	
Manganese	6010C	**258**	mg/Kg	0.23	2	05/03/17 12:14	05/01/17	
Mercury	7471B	**0.287**	mg/Kg	0.025	1	05/03/17 11:32	05/02/17	
Nickel	6020A	**6.30**	mg/Kg	0.23	5	05/03/17 09:05	05/01/17	
Potassium	6010C	**3800**	mg/Kg	45	2	05/03/17 12:14	05/01/17	
Selenium	6020A	ND U	mg/Kg	1.1	5	05/03/17 09:05	05/01/17	
Silver	6020A	**0.521**	mg/Kg	0.023	5	05/03/17 09:05	05/01/17	
Sodium	6010C	**3420**	mg/Kg	45	2	05/03/17 12:14	05/01/17	
Thallium	6020A	**0.280**	mg/Kg	0.023	5	05/03/17 09:05	05/01/17	
Vanadium	6020A	**42.7**	mg/Kg	0.23	5	05/03/17 09:05	05/01/17	
Zinc	6010C	**261**	mg/Kg	1.1	2	05/03/17 12:14	05/01/17	

Printed 5/4/2017 10:39:25 AM

Superset Reference:

Analytical Report

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704246
Date Collected: 04/26/17 17:00
Date Received: 04/29/17 09:10

Sample Name: SED17-06
Lab Code: K1704246-003

Basis: Dry

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**7660**	mg/Kg	2.3	2	05/03/17 12:16	05/01/17	
Antimony	6020A	ND U	mg/Kg	0.057	5	05/03/17 09:09	05/01/17	
Arsenic	6020A	**1.85**	mg/Kg	0.57	5	05/03/17 09:09	05/01/17	
Barium	6010C	**163**	mg/Kg	0.92	2	05/03/17 12:16	05/01/17	
Beryllium	6020A	**0.177**	mg/Kg	0.023	5	05/03/17 09:09	05/01/17	
Cadmium	6020A	**0.214**	mg/Kg	0.023	5	05/03/17 09:09	05/01/17	
Calcium	6010C	**2920**	mg/Kg	4.6	2	05/03/17 12:16	05/01/17	
Chromium	6020A	**9.91**	mg/Kg	0.23	5	05/03/17 09:09	05/01/17	
Cobalt	6020A	**5.25**	mg/Kg	0.023	5	05/03/17 09:09	05/01/17	
Copper	6020A	**43.2**	mg/Kg	0.11	5	05/03/17 09:09	05/01/17	
Iron	6010C	**15500**	mg/Kg	4.6	2	05/03/17 12:16	05/01/17	
Lead	6020A	**73.5**	mg/Kg	0.057	5	05/03/17 09:09	05/01/17	
Magnesium	6010C	**5150**	mg/Kg	2.3	2	05/03/17 12:16	05/01/17	
Manganese	6010C	**209**	mg/Kg	0.23	2	05/03/17 12:16	05/01/17	
Mercury	7471B	**0.071**	mg/Kg	0.020	1	05/03/17 11:34	05/02/17	
Nickel	6020A	**5.26**	mg/Kg	0.23	5	05/03/17 09:09	05/01/17	
Potassium	6010C	**3380**	mg/Kg	46	2	05/03/17 12:16	05/01/17	
Selenium	6020A	ND U	mg/Kg	1.1	5	05/03/17 09:09	05/01/17	
Silver	6020A	**0.164**	mg/Kg	0.023	5	05/03/17 09:09	05/01/17	
Sodium	6010C	**3540**	mg/Kg	46	2	05/03/17 12:16	05/01/17	
Thallium	6020A	**0.192**	mg/Kg	0.023	5	05/03/17 09:09	05/01/17	
Vanadium	6020A	**35.6**	mg/Kg	0.23	5	05/03/17 09:09	05/01/17	
Zinc	6010C	**114**	mg/Kg	1.1	2	05/03/17 12:16	05/01/17	

Client: Golder Associates, Inc. **Service Request:** K1704246
Project: Skagway-Sediment 2017/1657231 **Date Collected:** NA
Sample Matrix: Sediment **Date Received:** NA

Sample Name: Method Blank **Basis:** Dry
Lab Code: KQ1705236-01

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	ND U	mg/Kg	2	2	05/03/17 11:51	05/01/17	
Antimony	6020A	ND U	mg/Kg	0.05	5	05/03/17 08:37	05/01/17	
Arsenic	6020A	ND U	mg/Kg	0.5	5	05/03/17 08:37	05/01/17	
Barium	6010C	ND U	mg/Kg	0.8	2	05/03/17 11:51	05/01/17	
Beryllium	6020A	ND U	mg/Kg	0.020	5	05/03/17 08:37	05/01/17	
Cadmium	6020A	ND U	mg/Kg	0.020	5	05/03/17 08:37	05/01/17	
Calcium	6010C	ND U	mg/Kg	4	2	05/03/17 11:51	05/01/17	
Chromium	6020A	ND U	mg/Kg	0.20	5	05/03/17 08:37	05/01/17	
Cobalt	6020A	ND U	mg/Kg	0.020	5	05/03/17 08:37	05/01/17	
Copper	6020A	ND U	mg/Kg	0.10	5	05/03/17 08:37	05/01/17	
Iron	6010C	ND U	mg/Kg	4	2	05/03/17 11:51	05/01/17	
Lead	6020A	ND U	mg/Kg	0.05	5	05/03/17 08:37	05/01/17	
Magnesium	6010C	ND U	mg/Kg	2	2	05/03/17 11:51	05/01/17	
Manganese	6010C	ND U	mg/Kg	0.2	2	05/03/17 11:51	05/01/17	
Nickel	6020A	ND U	mg/Kg	0.20	5	05/03/17 08:37	05/01/17	
Potassium	6010C	ND U	mg/Kg	40	2	05/03/17 11:51	05/01/17	
Selenium	6020A	ND U	mg/Kg	1.0	5	05/03/17 08:37	05/01/17	
Silver	6020A	ND U	mg/Kg	0.020	5	05/03/17 08:37	05/01/17	
Sodium	6010C	ND U	mg/Kg	40	2	05/03/17 11:51	05/01/17	
Thallium	6020A	ND U	mg/Kg	0.020	5	05/03/17 08:37	05/01/17	
Vanadium	6020A	ND U	mg/Kg	0.20	5	05/03/17 08:37	05/01/17	
Zinc	6010C	ND U	mg/Kg	1.0	2	05/03/17 11:51	05/01/17	

Client: Golder Associates, Inc. **Service Request:** K1704246
Project: Skagway-Sediment 2017/1657231 **Date Collected:** NA
Sample Matrix: Sediment **Date Received:** NA

Sample Name: Method Blank **Basis:** Dry
Lab Code: KQ1705270-01

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Mercury	7471B	ND U	mg/Kg	0.02	1	05/03/17 11:03	05/02/17	

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	04/25/17
Sample Matrix:	Sediment	**Date Received:**	04/29/17
		Date Analyzed:	05/03/17

Replicate Sample Summary
Total Metals

Sample Name:	SED17-05	**Units:**	mg/Kg
Lab Code:	K1704246-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1705236-03 Result	Average	RPD	RPD Limit
Aluminum	6010C	2.4	10800	11000	10900	2	20
Antimony	6020A	0.061	ND U	ND U	ND	-	20
Arsenic	6020A	0.61	2.03	2.47	2.25	19	20
Barium	6010C	0.97	235	247	241	5	20
Beryllium	6020A	0.024	0.197	0.206	0.202	5	20
Cadmium	6020A	0.024	0.248	0.241	0.245	3	20
Calcium	6010C	4.9	6240	4530	5390	32 *	20
Chromium	6020A	0.24	11.7	11.9	11.8	1	20
Cobalt	6020A	0.024	5.66	5.80	5.73	2	20
Copper	6020A	0.12	34.3	34.8	34.6	1	20
Iron	6010C	4.9	21500	22000	21800	2	20
Lead	6020A	0.061	82.6	88.1	85.4	7	20
Magnesium	6010C	2.4	7130	7160	7150	<1	20
Manganese	6010C	0.24	286	296	291	3	20
Nickel	6020A	0.24	6.18	6.21	6.20	<1	20
Potassium	6010C	49	4940	5060	5000	3	20
Selenium	6020A	1.2	ND U	ND U	ND	-	20
Silver	6020A	0.024	0.287	0.180	0.234	46 *	20
Sodium	6010C	49	4740	4760	4750	<1	20
Thallium	6020A	0.024	0.247	0.228	0.238	8	20
Vanadium	6020A	0.24	38.5	40.2	39.4	4	20
Zinc	6010C	1.2	171	164	168	4	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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Superset Reference:

ALS Group USA, Corp.
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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	04/25/17
Sample Matrix:	Sediment	**Date Received:**	04/29/17
		Date Analyzed:	05/03/17

Replicate Sample Summary
Total Metals

Sample Name:	SED17-05	**Units:**	mg/Kg
Lab Code:	K1704246-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1705270-10 Result	Average	RPD	RPD Limit
Mercury	7471B	0.025	0.139	0.119	0.129	16	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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Superset Reference:

ALS Group USA, Corp.
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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/25/17
Sample Matrix:	Sediment	**Date Received:**	04/29/17
		Date Analyzed:	5/3/17

Matrix Spike Summary
Total Metals

Sample Name:	SED17-05	**Units:**	mg/Kg
Lab Code:	K1704246-001	**Basis:**	Dry

Matrix Spike
KQ1705236-04

Analyte Name	Method	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6010C	10800	10900	453	12 #	75-125
Antimony	6020A	ND U	32.6	113	29 N	75-125
Arsenic	6020A	2.03	115	113	100	75-125
Barium	6010C	235	456	226	98	75-125
Beryllium	6020A	0.197	11.4	11.3	99	75-125
Cadmium	6020A	0.248	11.9	11.3	103	75-125
Calcium	6010C	6240	6030	1130	-19 #	75-125
Chromium	6020A	11.7	55.8	45.3	98	75-125
Cobalt	6020A	5.66	121	113	102	75-125
Copper	6020A	34.3	92.5	56.6	103	75-125
Iron	6010C	21500	21300	226	-60 #	75-125
Lead	6020A	82.6	179	113	85	75-125
Magnesium	6010C	7130	8110	1130	87 #	75-125
Manganese	6010C	286	391	113	93	75-125
Nickel	6020A	6.18	120	113	100	75-125
Potassium	6010C	4940	5890	1130	85 #	75-125
Selenium	6020A	ND U	113	113	100	75-125
Silver	6020A	0.287	11.3	11.3	98	75-125
Sodium	6010C	4740	5810	1130	95 #	75-125
Thallium	6020A	0.247	22.1	22.6	97	75-125
Vanadium	6020A	38.5	151	113	100	75-125
Zinc	6010C	171	265	113	83	75-125

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 5/4/2017 10:39:25 AM   Superset Reference:

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/25/17
Sample Matrix:	Sediment	**Date Received:**	04/29/17
		Date Analyzed:	05/3/17
		Date Extracted:	05/2/17

Matrix Spike Summary
Total Metals

Sample Name:	SED17-05	**Units:**	mg/Kg
Lab Code:	K1704246-001	**Basis:**	Dry
Analysis Method:	7471B		
Prep Method:	Method		

Matrix Spike
KQ1705270-11

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Mercury	0.139	0.710	0.592	96	80-120

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/03/17
Sample Matrix:	Sediment		

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1705236-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6010C	7560	7930	95	39-161
Barium	6010C	332	308	108	74-126
Calcium	6010C	6920	6610	105	74-126
Iron	6010C	12900	14400	89	36-164
Magnesium	6010C	2730	2640	103	64-136
Manganese	6010C	432	410	105	76-124
Potassium	6010C	2620	2550	103	61-139
Sodium	6010C	3350	2480	135	65-173
Zinc	6010C	197	191	103	70-130

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/03/17
Sample Matrix:	Sediment		

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1705236-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Antimony	6020A	67.3	105	64	20-254
Arsenic	6020A	102	98.5	104	69-145
Beryllium	6020A	74.5	66.0	113	74-126
Cadmium	6020A	175	146	120	73-127
Chromium	6020A	199	182	110	71-130
Cobalt	6020A	190	162	118	74-125
Copper	6020A	115	106	108	75-125
Lead	6020A	137	130	105	72-127
Nickel	6020A	179	149	120	73-127
Selenium	6020A	169	154	110	68-132
Silver	6020A	43.4	40.9	106	66-134
Thallium	6020A	194	175	111	69-131
Vanadium	6020A	107	96.7	111	65-135

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704246
Date Analyzed: 05/03/17

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1705270-03

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Mercury	7471B	7.13	7.10	100	51-149

Polynuclear Aromatic Hydrocarbons

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/25/2017
Sample Matrix:	Sediment	**Date Received:**	04/29/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-05	**Units:**	ug/Kg
Lab Code:	K1704246-001	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.7	1	05/02/17	05/04/17	KWG1703532	
2-Methylnaphthalene	ND	U	6.7	1	05/02/17	05/04/17	KWG1703532	
Acenaphthylene	**10**		6.7	1	05/02/17	05/04/17	KWG1703532	*
Acenaphthene	ND	U	6.7	1	05/02/17	05/04/17	KWG1703532	
Dibenzofuran	ND	U	6.7	1	05/02/17	05/04/17	KWG1703532	
Fluorene	ND	U	6.7	1	05/02/17	05/04/17	KWG1703532	
Phenanthrene	**33**		6.7	1	05/02/17	05/04/17	KWG1703532	
Anthracene	**25**		6.7	1	05/02/17	05/04/17	KWG1703532	
Fluoranthene	**160**		6.7	1	05/02/17	05/04/17	KWG1703532	
Pyrene	**160**		6.7	1	05/02/17	05/04/17	KWG1703532	
Benz(a)anthracene	**150**		6.7	1	05/02/17	05/04/17	KWG1703532	*
Chrysene	**150**		6.7	1	05/02/17	05/04/17	KWG1703532	
Benzo(b)fluoranthene†	**140**		6.7	1	05/02/17	05/04/17	KWG1703532	
Benzo(k)fluoranthene	**57**		6.7	1	05/02/17	05/04/17	KWG1703532	
Benzo(a)pyrene	**73**		6.7	1	05/02/17	05/04/17	KWG1703532	
Indeno(1,2,3-cd)pyrene	**29**		6.7	1	05/02/17	05/04/17	KWG1703532	
Dibenz(a,h)anthracene	**8.8**		6.7	1	05/02/17	05/04/17	KWG1703532	
Benzo(g,h,i)perylene	**25**		6.7	1	05/02/17	05/04/17	KWG1703532	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	89	38-104	05/04/17	Acceptable
Fluoranthene-d10	100	39-109	05/04/17	Acceptable
Terphenyl-d14	110	38-113	05/04/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/26/2017
Sample Matrix:	Sediment	**Date Received:**	04/29/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-08	**Units:**	ug/Kg
Lab Code:	K1704246-002	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.2	1	05/02/17	05/04/17	KWG1703532	
2-Methylnaphthalene	ND	U	6.2	1	05/02/17	05/04/17	KWG1703532	
Acenaphthylene	ND	U	6.2	1	05/02/17	05/04/17	KWG1703532	*
Acenaphthene	ND	U	6.2	1	05/02/17	05/04/17	KWG1703532	
Dibenzofuran	ND	U	6.2	1	05/02/17	05/04/17	KWG1703532	
Fluorene	**15**		6.2	1	05/02/17	05/04/17	KWG1703532	
Phenanthrene	**77**		6.2	1	05/02/17	05/04/17	KWG1703532	
Anthracene	**21**		6.2	1	05/02/17	05/04/17	KWG1703532	
Fluoranthene	**150**		6.2	1	05/02/17	05/04/17	KWG1703532	
Pyrene	**100**		6.2	1	05/02/17	05/04/17	KWG1703532	
Benz(a)anthracene	**83**		6.2	1	05/02/17	05/04/17	KWG1703532	*
Chrysene	**150**		6.2	1	05/02/17	05/04/17	KWG1703532	
Benzo(b)fluoranthene†	**94**		6.2	1	05/02/17	05/04/17	KWG1703532	
Benzo(k)fluoranthene	**37**		6.2	1	05/02/17	05/04/17	KWG1703532	
Benzo(a)pyrene	**40**		6.2	1	05/02/17	05/04/17	KWG1703532	
Indeno(1,2,3-cd)pyrene	**17**		6.2	1	05/02/17	05/04/17	KWG1703532	
Dibenz(a,h)anthracene	ND	U	6.2	1	05/02/17	05/04/17	KWG1703532	
Benzo(g,h,i)perylene	**14**		6.2	1	05/02/17	05/04/17	KWG1703532	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	80	38-104	05/04/17	Acceptable
Fluoranthene-d10	88	39-109	05/04/17	Acceptable
Terphenyl-d14	88	38-113	05/04/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/26/2017
Sample Matrix:	Sediment	**Date Received:**	04/29/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-06	**Units:**	ug/Kg
Lab Code:	K1704246-003	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.3	1	05/02/17	05/04/17	KWG1703532	
2-Methylnaphthalene	ND	U	6.3	1	05/02/17	05/04/17	KWG1703532	
Acenaphthylene	ND	U	6.3	1	05/02/17	05/04/17	KWG1703532	*
Acenaphthene	ND	U	6.3	1	05/02/17	05/04/17	KWG1703532	
Dibenzofuran	ND	U	6.3	1	05/02/17	05/04/17	KWG1703532	
Fluorene	ND	U	6.3	1	05/02/17	05/04/17	KWG1703532	
Phenanthrene	**27**		6.3	1	05/02/17	05/04/17	KWG1703532	
Anthracene	**13**		6.3	1	05/02/17	05/04/17	KWG1703532	
Fluoranthene	**73**		6.3	1	05/02/17	05/04/17	KWG1703532	
Pyrene	**51**		6.3	1	05/02/17	05/04/17	KWG1703532	
Benz(a)anthracene	**46**		6.3	1	05/02/17	05/04/17	KWG1703532	*
Chrysene	**40**		6.3	1	05/02/17	05/04/17	KWG1703532	
Benzo(b)fluoranthene†	**72**		6.3	1	05/02/17	05/04/17	KWG1703532	
Benzo(k)fluoranthene	**29**		6.3	1	05/02/17	05/04/17	KWG1703532	
Benzo(a)pyrene	**36**		6.3	1	05/02/17	05/04/17	KWG1703532	
Indeno(1,2,3-cd)pyrene	**15**		6.3	1	05/02/17	05/04/17	KWG1703532	
Dibenz(a,h)anthracene	ND	U	6.3	1	05/02/17	05/04/17	KWG1703532	
Benzo(g,h,i)perylene	**12**		6.3	1	05/02/17	05/04/17	KWG1703532	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	71	38-104	05/04/17	Acceptable
Fluoranthene-d10	84	39-109	05/04/17	Acceptable
Terphenyl-d14	81	38-113	05/04/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704246
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Polynuclear Aromatic Hydrocarbons

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG1703532-5	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
2-Methylnaphthalene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Acenaphthylene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	*
Acenaphthene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Dibenzofuran	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Fluorene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Phenanthrene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Anthracene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Fluoranthene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Pyrene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Benz(a)anthracene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	*
Chrysene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Benzo(b)fluoranthene†	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Benzo(k)fluoranthene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Benzo(a)pyrene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Indeno(1,2,3-cd)pyrene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Dibenz(a,h)anthracene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	
Benzo(g,h,i)perylene	ND	U	4.9	1	05/02/17	05/04/17	KWG1703532	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	76	38-104	05/04/17	Acceptable
Fluoranthene-d10	84	39-109	05/04/17	Acceptable
Terphenyl-d14	84	38-113	05/04/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

QA/QC Report

Client: Golder Associates, Inc.
Service Request: K1704246
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Soil

Surrogate Recovery Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3546
Units: Percent
Analysis Method: 8270D SIM
Level: Low

Sample Name	Lab Code	Sur1	Sur2	Sur3
Batch QC	K1704128-007	83 D	101 D	48
SED17-05	K1704246-001	89	100	110
SED17-08	K1704246-002	80	88	88
SED17-06	K1704246-003	71	84	81
Method Blank	KWG1703532-5	76	84	84
Batch QCMS	KWG1703532-1	82 D	93 D	58
Batch QCDMS	KWG1703532-2	81 D	92 D	58
Lab Control Sample	KWG1703532-3	70	80	80
Duplicate Lab Control Sample	KWG1703532-4	71	78	77

Surrogate Recovery Control Limits (%)

Sur1	=	Fluorene-d10	38-104
Sur2	=	Fluoranthene-d10	39-109
Sur3	=	Terphenyl-d14	38-113

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Soil

Service Request: K1704246
Date Extracted: 05/02/2017
Date Analyzed: 05/04/2017 - 05/05/2017

Matrix Spike/Duplicate Matrix Spike Summary
Polynuclear Aromatic Hydrocarbons

Sample Name: Batch QC
Lab Code: K1704128-007
Extraction Method: EPA 3546
Analysis Method: 8270D SIM

Units: ug/Kg
Basis: Dry
Level: Low
Extraction Lot: KWG1703532

		Batch QCMS KWG1703532-1 Matrix Spike			Batch QCDMS KWG1703532-2 Duplicate Matrix Spike					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	690	900	634	33	762	621	12 *	29-88	17	40
2-Methylnaphthalene	2400	1800	634	-96 *	1480	621	-149 *	28-98	19	40
Acenaphthylene	87	575	634	77	615	621	85	32-97	7	40
Acenaphthene	240	659	634	66	660	621	68	30-101	0	40
Dibenzofuran	130	751	634	98	619	621	79	28-105	19	40
Fluorene	580	882	634	47	841	621	41	23-116	5	40
Phenanthrene	950	1130	634	30	1050	621	17	10-128	7	40
Anthracene	160	556	634	63	609	621	72	27-116	9	40
Fluoranthene	ND	654	634	103	708	621	114	10-138	8	40
Pyrene	110	489	634	59	527	621	67	16-134	8	40
Benz(a)anthracene	ND	654	634	103	659	621	106	27-127	1	40
Chrysene	ND	634	634	100	632	621	102	25-132	0	40
Benzo(b)fluoranthene	ND	591	634	93	605	621	97	21-130	2	40
Benzo(k)fluoranthene	ND	592	634	93	597	621	96	22-126	1	40
Benzo(a)pyrene	ND	558	634	88	585	621	94	25-129	5	40
Indeno(1,2,3-cd)pyrene	ND	623	634	98	636	621	102	17-138	2	40
Dibenz(a,h)anthracene	ND	567	634	89	576	621	93	32-116	2	40
Benzo(g,h,i)perylene	ND	558	634	88	571	621	92	17-130	2	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Soil

Service Request: K1704246
Date Extracted: 05/02/2017
Date Analyzed: 05/04/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3546
Analysis Method: 8270D SIM

Units: ug/Kg
Basis: Dry
Level: Low
Extraction Lot: KWG1703532

	Lab Control Sample KWG1703532-3 **Lab Control Spike**			Duplicate Lab Control Sample KWG1703532-4 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	413	500	83	409	500	82	42-88	1	40
2-Methylnaphthalene	432	500	86	432	500	86	43-92	0	40
Acenaphthylene	474	500	95 *	473	500	95 *	44-93	0	40
Acenaphthene	441	500	88	439	500	88	44-95	1	40
Dibenzofuran	462	500	92	458	500	92	44-96	1	40
Fluorene	463	500	93	460	500	92	45-98	1	40
Phenanthrene	447	500	89	448	500	90	41-99	0	40
Anthracene	473	500	95	466	500	93	46-100	1	40
Fluoranthene	484	500	97	473	500	95	49-102	2	40
Pyrene	486	500	97	470	500	94	48-104	3	40
Benz(a)anthracene	532	500	106 *	526	500	105	52-105	1	40
Chrysene	497	500	99	494	500	99	51-110	1	40
Benzo(b)fluoranthene	515	500	103	515	500	103	52-114	0	40
Benzo(k)fluoranthene	512	500	102	513	500	103	52-112	0	40
Benzo(a)pyrene	505	500	101	507	500	101	52-111	0	40
Indeno(1,2,3-cd)pyrene	555	500	111	548	500	110	44-117	1	40
Dibenz(a,h)anthracene	502	500	100	495	500	99	44-110	1	40
Benzo(g,h,i)perylene	492	500	98	494	500	99	45-107	1	40

Results flagged with an asterisk (*) indicate values outside control criteria.

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May 31, 2017

Analytical Report for Service Request No: K1704247

Tamra Reynolds
Golder Associates Ltd.
Suite 201C, 170 Titanium Way
Whitehorse, YT Y1A0G1

RE: Skagway-Sediment 2017 / 1657231

Dear Tamra,

Enclosed are the results of the sample(s) submitted to our laboratory April 29, 2017
For your reference, these analyses have been assigned our service request number **K1704247.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3364. You may also contact me via email at howard.holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Howard Holmes
Project Manager

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Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- E The result is an estimate amount because the value exceeded the instrument calibration range.
- J The result is an estimated value.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.
- H The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

- # The control limit criteria is not applicable. See case narrative.
- J The result is an estimated value.
- E The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
- M The duplicate injection precision was not met.
- N The Matrix Spike sample recovery is not within control limits. See case narrative.
- S The reported value was determined by the Method of Standard Additions (MSA).
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- W The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- + The correlation coefficient for the MSA is less than 0.995.
- Q See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- A A tentatively identified compound, a suspected aldol-condensation product.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- C The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
- D The reported result is from a dilution.
- E The result is an estimated value.
- J The result is an estimated value.
- N The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
- P The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

- F The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
- L The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
- H The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
- O The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
- Y The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
- Z The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEH	http://dec.alaska.gov/eh/lab/cs/csapproval.htm	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	http://health.hawaii.gov/	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/page/la-lab-accreditation	03016
Maine DHS	http://www.maine.gov/dhhs/	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/enforcement/oqa.html	WA005
New York - DOH	https://www.wadsworth.org/regulatory/elap	12060
North Carolina DEQ	https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/EnvironmentalLabCertification/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water-	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS Environmental—Kelso Laboratory
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ALS ENVIRONMENTAL

Client:	Golder Associates, Inc.	**Service Request No.:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Received:**	04/29/17
Sample Matrix:	Sediment		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt

Three sediment samples were received for analysis at ALS Environmental on 04/29/17. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry Parameters

No other anomalies associated with the analysis of these samples were observed.

Total Metals

No other anomalies associated with the analysis of these samples were observed.

Diesel and Residual Range Organics

Matrix Spike Recovery Exceptions:
The matrix spike recovery of all analyte(s) for sample SED17-05 was outside control criteria. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. The matrix spike outlier suggested a potential bias in this matrix. No further corrective action was appropriate.

No other anomalies associated with the analysis of these samples were observed.

Approved by____________________________________

Chain of Custody

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K1704247
~~K1704246~~ cg 4/29

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 - 594998

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates LTD
Contact:	Tamra Reynolds
Phone:	1-867-633-4468
	Company address below will appear on the final report
Street:	170-201C Titanium Way
City/Province:	Whitehorse, Yukon
Postal Code:	Y1A 0G1

Report Format / Distribution

Select Report Format: [x] PDF [x] EXCEL [ ] EDD (DIGITAL)

Quality Control (QC) Report with Report [x] YES [ ] NO

[ ] Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: [x] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax TJREYNOLDS@golder.com

Email 2 PADDY_MCMANUS@golder.com

Email 3 VMERCER@golder.com

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] [x] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] [x] 3 day [P3] [ ] 2 day [P2] [ ]

EMERGENCY: 1 Business day [E1] [ ] Same Day, Weekend or Statutory holiday [E0] [ ]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Invoice To		
	Same as Report To	[x] YES [ ] NO
	Copy of Invoice with Report	[x] YES [ ] NO
Company:		
Contact:		

Invoice Distribution

Select Invoice Distribution: [x] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax Same as report

Email 2

Project Information

ALS Account # / Quote #: 41037

Job #: 1657231

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#

Major/Minor Code: | Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Peyfair

Sampler: PM / JM

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals	PAHs	Grainsize (GS)	Total Organic Carbon (TOC)	DRO	AVS/SEM	Number of Containers
	SED17-05	25-Apr-17	17:00	Sediment	X	X	X	X			5
	SED17-08	26-APR-17	17:00	↓	↓	↓	↓	↓			6
	SED17-06	26-APR-17	17:00	↓	↓	↓	↓	↓			6

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [x] NO

Are samples for human drinking water use? [ ] YES [x] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Please archive unused samples. 5-day turnaround on metals and PAHs, regular turn around on GS and TOC. Wait for directions for DRO : AVS/SEM

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [ ]

Ice Packs [ ] Ice Cubes [ ] Custody seal intact Yes [ ] No [ ]

Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 27-APR-17	Time: 7:00am	Received by: [signature]	Date: 4/29/17	Time: 0910	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS

PC HH

Cooler Receipt and Preservation Form

ient Golder Associates LTD. Service Request ~~K17~~04246 CG 4/29 K1704247

eceived: 4/29/17 Opened: 4/29/17 By: CG Unloaded: 4/29/17 By: CG

Samples were received via? *USPS* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*

Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* NA

Were custody seals on coolers? NA Y N If yes, how many and where? 1 Front

If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
1.2	1.1	3.3	3.2	-0.1	375		027 1941 1092	✓

Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* Box w/dividers

Were custody papers properly filled out (ink, signed, etc.)? NA Y N

Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA Y N

If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*

Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N

Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N

Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N

). Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N

. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N

. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

tes, Discrepancies, & Resolutions:

RUSH

7/25/16

Page ____ *of* ____

Total Solids

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/25/17 - 04/26/17
Sample Matrix:	Sediment	**Date Received:**	04/29/17
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
SED17-05	K1704247-001	**75.3**	-	1	05/01/17 17:04	
SED17-08	K1704247-002	**73.9**	-	1	05/01/17 17:04	
SED17-06	K1704247-003	**78.3**	-	1	05/01/17 17:04	

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Solid Fuel	**Date Received:**	NA
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Batch QC	K1704164-001DUP	-	52.3	55.5	53.9	6	20	05/01/17
Batch QC	K1704246-001DUP	-	73.5	74.3	73.9	1	20	05/01/17

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

General Chemistry

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www.alsglobal.com

Client:	Golder Associates, Inc.		**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231		**Date Collected:**	04/25/17 - 04/26/17
Sample Matrix:	Sediment		**Date Received:**	04/29/17
Analysis Method:	821/R-91-100		**Units:**	uMole/g
Prep Method:	Method		**Basis:**	Dry

Sulfide, Acid-Volatile

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Date Extracted	Q
SED17-05	K1704247-001	ND U	0.031	1	05/08/17 21:09	5/8/17	
SED17-08	K1704247-002	**0.094**	0.032	1	05/08/17 21:09	5/8/17	
SED17-06	K1704247-003	ND U	0.039	1	05/08/17 21:09	5/8/17	
Method Blank	K1704247-MB	ND U	0.016	1	05/08/17 21:09	5/8/17	

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	04/25/17
Sample Matrix:	Sediment	**Date Received:**	04/29/17
		Date Analyzed:	05/08/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	SED17-05	**Units:**	uMole/g
Lab Code:	K1704247-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1704247-001DUP Result	Average	RPD	RPD Limit
Sulfide, Acid-Volatile	821/R-91-100	0.032	ND U	0.041	NC	NC	45

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/25/17
Sample Matrix:	Sediment	**Date Received:**	04/29/17
		Date Analyzed:	05/8/17
		Date Extracted:	05/8/17

Duplicate Matrix Spike Summary
Sulfide, Acid-Volatile

Sample Name:	SED17-05	**Units:**	uMole/g
Lab Code:	K1704247-001	**Basis:**	Dry
Analysis Method:	821/R-91-100		
Prep Method:	Method		

		Matrix Spike K1704247-001MS			Duplicate Matrix Spike K1704247-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Sulfide, Acid-Volatile	ND U	20.2	21.9	93	19.7	21.0	94	56-142	3	45

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/08/17
Sample Matrix:	Sediment	**Date Extracted:**	05/08/17

Lab Control Sample Summary
Sulfide, Acid-Volatile

Analysis Method:	821/R-91-100	**Units:**	uMole/g
Prep Method:	Method	**Basis:**	Dry
		Analysis Lot:	544873

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1704247-LCS	0.211	0.228	93	60-115

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Analytical Report

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704247
Date Collected: 4/25/2017
Date Received: 4/29/2017
Date Analyzed: 5/2/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-05
Lab Code: K1704247-001

Sand Fraction: Weight (Grams)	25.0545
Sand Fraction: Weight Recovered (Grams)	24.8257
Sand Fraction: Percent Recovery	99.09

Weight as received (Grams)	51.293
Percent Solids	84.0
Weight Oven-Dried (Grams)	43.0861

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.2472	0.57
Gravel, Fine	2.00 mm	10	0.6458	1.50
Sand, Very Coarse	0.850 mm	20	1.4149	3.28
Sand, Coarse	0.425 mm	40	3.1564	7.33
Sand, Medium	0.250 mm	60	3.8373	8.91
Sand, Fine	0.106 mm	140	9.1521	21.24
Sand, Very Fine	0.075 mm	200	5.3811	12.49
Silt			13.6600	31.70
Clay			4.6850	10.87
		Total	42.1798	97.89

ALS Group USA, Corp.
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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	4/26/2017
Sample Matrix:	Sediment	**Date Received:**	4/29/2017
		Date Analyzed:	5/2/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-08
Lab Code: K1704247-002

Sand Fraction: Weight (Grams)	42.4759
Sand Fraction: Weight Recovered (Grams)	42.3734
Sand Fraction: Percent Recovery	99.76

Weight as received (Grams)	72.291
Percent Solids	82.7
Weight Oven-Dried (Grams)	59.7847

Description	**Sieve Size**	**Sieve Number**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	4.75 mm	4	0.0000	0.00
Gravel, Fine	2.00 mm	10	0.9354	1.56
Sand, Very Coarse	0.850 mm	20	6.2420	10.44
Sand, Coarse	0.425 mm	40	10.1673	17.01
Sand, Medium	0.250 mm	60	7.0896	11.86
Sand, Fine	0.106 mm	140	11.6516	19.49
Sand, Very Fine	0.075 mm	200	4.8867	8.17
Silt			13.3000	22.25
Clay			4.5300	7.58
		Total	58.8026	98.36

ALS Group USA, Corp.
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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	4/26/2017
Sample Matrix:	Sediment	**Date Received:**	4/29/2017
		Date Analyzed:	5/2/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-06
Lab Code: K1704247-003

Sand Fraction: Weight (Grams)	54.2228
Sand Fraction: Weight Recovered (Grams)	54.2572
Sand Fraction: Percent Recovery	100.06

Weight as received (Grams)	71.737
Percent Solids	89.6
Weight Oven-Dried (Grams)	64.2764

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	11.5326	17.94
Gravel, Fine	2.00 mm	10	2.6676	4.15
Sand, Very Coarse	0.850 mm	20	9.3388	14.53
Sand, Coarse	0.425 mm	40	11.4906	17.88
Sand, Medium	0.250 mm	60	7.2131	11.22
Sand, Fine	0.106 mm	140	8.9554	13.93
Sand, Very Fine	0.075 mm	200	2.6894	4.18
Silt			7.2950	11.35
Clay			2.7000	4.20
		Total	63.8825	99.38

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	4/26/2017
Sample Matrix:	Sediment	**Date Received:**	4/29/2017
		Date Analyzed:	5/2/2017

Particle Size Determination

ASTM D422M

Sample Name: SED17-08

Lab Code: K1704247-002DUP

Sand Fraction: Weight (Grams)	42.7436
Sand Fraction: Weight Recovered (Grams)	42.6532
Sand Fraction: Percent Recovery	99.79

Weight as received (Grams)	72.002
Percent Solids	82.7
Weight Oven-Dried (Grams)	59.5457

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.7106	1.19
Gravel, Fine	2.00 mm	10	2.0352	3.42
Sand, Very Coarse	0.850 mm	20	5.5896	9.39
Sand, Coarse	0.425 mm	40	10.0057	16.80
Sand, Medium	0.250 mm	60	6.9415	11.66
Sand, Fine	0.106 mm	140	11.2195	18.84
Sand, Very Fine	0.075 mm	200	4.7153	7.92
Silt			13.6450	22.92
Clay			4.1800	7.02
		Total	59.0424	99.16

Client: Golder Associates, Inc.
Service Request: K1704247
Project: Skagway-Sediment 2017/1657231
Date Collected: 04/25/17 - 04/26/17
Sample Matrix: Sediment
Date Received: 04/29/17

Analysis Method: Walkley-Black
Units: mg/Kg
Prep Method: None
Basis: Dry

Carbon, Total Organic

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
SED17-05	K1704247-001	**3800**	2700	1	05/04/17 13:30	
SED17-08	K1704247-002	**4300**	2700	1	05/04/17 13:30	
SED17-06	K1704247-003	**3000**	2600	1	05/04/17 13:30	
Method Blank	K1704247-MB	ND U	2000	1	05/04/17 13:30	

QA/QC Report

Client: Golder Associates, Inc.
Project Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704247
Date Collected: 04/25/17
Date Received: 04/29/17
Date Analyzed: 05/04/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name: SED17-05
Lab Code: K1704247-001

Units: mg/Kg
Basis: Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1704247-001DUP Result	Average	RPD	RPD Limit
Carbon, Total Organic	Walkley-Black	2700	3800	4100	3950	8	20

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Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/04/17
Sample Matrix:	Sediment	**Date Extracted:**	NA

Lab Control Sample Summary
Carbon, Total Organic

Analysis Method:	Walkley-Black	**Units:**	mg/Kg
Prep Method:	None	**Basis:**	Dry
		Analysis Lot:	544217

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1704247-LCS	6100	5400	113	85-115

Metals

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Simultaneously Extractable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704247
Project No.: 1657231
Date Collected: 4/25/2017
Project Name: Skagway-Sediment 2017
Date Received: 4/29/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-05
Lab Code: K1704247-001

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.006	1.0	05/08/17	05/11/17	0.006	U	
Arsenic	6010C	0.010	1.0	05/08/17	05/11/17	0.010	U	
Cadmium	6010C	0.0004	1.0	05/08/17	05/11/17	0.0004		
Chromium	6010C	0.004	1.0	05/08/17	05/11/17	0.012		
Copper	6010C	0.004	1.0	05/08/17	05/11/17	0.121		
Lead	6010C	0.002	1.0	05/08/17	05/11/17	0.226		
Mercury	7470A	0.00008	4.0	05/08/17	05/15/17	0.00008	U	
Nickel	6010C	0.002	1.0	05/08/17	05/11/17	0.011		
Silver	6010C	0.002	1.0	05/08/17	05/11/17	0.002	U	
Zinc	6010C	0.006	1.0	05/08/17	05/11/17	0.946		

% Solids: 75.3

Comments:

Simultaneously Extractable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704247
Project No.: 1657231
Date Collected: 4/26/2017
Project Name: Skagway-Sediment 2017
Date Received: 4/29/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-08 **Lab Code:** K1704247-002

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.006	1.0	05/08/17	05/11/17	0.006	U	
Arsenic	6010C	0.010	1.0	05/08/17	05/11/17	0.010	U	
Cadmium	6010C	0.0004	1.0	05/08/17	05/11/17	0.0010		
Chromium	6010C	0.004	1.0	05/08/17	05/11/17	0.015		
Copper	6010C	0.004	1.0	05/08/17	05/11/17	0.172		
Lead	6010C	0.002	1.0	05/08/17	05/11/17	0.522		
Mercury	7470A	0.00008	4.0	05/08/17	05/15/17	0.00008	U	
Nickel	6010C	0.002	1.0	05/08/17	05/11/17	0.012		
Silver	6010C	0.002	1.0	05/08/17	05/11/17	0.002	U	
Zinc	6010C	0.006	1.0	05/08/17	05/11/17	1.150		

% Solids: 73.9

Comments:

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Simultaneously Extractable Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704247
Project No.: 1657231
Date Collected: 4/26/2017
Project Name: Skagway-Sediment 2017
Date Received: 4/29/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-06
Lab Code: K1704247-003

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.007	1.0	05/08/17	05/11/17	0.007	U	
Arsenic	6010C	0.012	1.0	05/08/17	05/11/17	0.012	U	
Cadmium	6010C	0.0005	1.0	05/08/17	05/11/17	0.0005	U	
Chromium	6010C	0.005	1.0	05/08/17	05/11/17	0.008		
Copper	6010C	0.005	1.0	05/08/17	05/11/17	0.104		
Lead	6010C	0.002	1.0	05/08/17	05/11/17	0.145		
Mercury	7470A	0.00010	4.0	05/08/17	05/15/17	0.00010	U	
Nickel	6010C	0.002	1.0	05/08/17	05/11/17	0.007		
Silver	6010C	0.002	1.0	05/08/17	05/11/17	0.002	U	
Zinc	6010C	0.007	1.0	05/08/17	05/11/17	0.356		

% Solids: 78.3

Comments:

Simultaneously Extractable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704247
Project No.: 1657231
Date Collected:
Project Name: Skagway-Sediment 2017
Date Received:
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: Method Blank
Lab Code: K1704247-MB

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.003	1.0	05/08/17	05/11/17	0.003	U	
Arsenic	6010C	0.005	1.0	05/08/17	05/11/17	0.005	U	
Cadmium	6010C	0.0002	1.0	05/08/17	05/11/17	0.0002	U	
Chromium	6010C	0.002	1.0	05/08/17	05/11/17	0.002	U	
Copper	6010C	0.002	1.0	05/08/17	05/11/17	0.002	U	
Lead	6010C	0.001	1.0	05/08/17	05/11/17	0.001	U	
Nickel	6010C	0.001	1.0	05/08/17	05/11/17	0.001	U	
Silver	6010C	0.001	1.0	05/08/17	05/11/17	0.001	U	
Zinc	6010C	0.003	1.0	05/08/17	05/11/17	0.003	U	

% Solids: 100.0

Comments:

Simultaneously Extractable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project No.:	1657231	**Date Collected:**	
Project Name:	Skagway-Sediment 2017	**Date Received:**	
Matrix:	SEDIMENT	**Units:**	umol/g
		Basis:	DRY

Sample Name: Method Blank **Lab Code:** KQ1705862-01

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Mercury	7470A	0.00004	4.0	05/08/17	05/15/17	0.00004	U	

% Solids: 100.0

Comments:

Simultaneously Extractable Metals

- 5A -

SPIKE SAMPLE RECOVERY

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project No.:	1657231	**Units:**	UMOLE/G
Project Name:	Skagway-Sediment 2017	**Basis:**	DRY
Matrix:	SEDIMENT	**% Solids:**	75.3

Sample Name: **SED17-05S** **Lab Code:** **K1704247-001S**

Analyte	Control Limit %R	Spike Result	C	Sample Result	C	Spike Added	%R	Q	Method
Antimony	75 - 125	0.071		0.006	U	0.079	90		6010C
Arsenic	75 - 125	0.632		0.010	U	0.641	99		6010C
Cadmium	75 - 125	0.2426		0.0004		0.213	114		6010C
Chromium	75 - 125	0.1890		0.0118		0.184	96		6010C
Copper	75 - 125	0.289		0.121		0.189	89		6010C
Lead	75 - 125	0.474		0.226		0.232	107		6010C
Mercury	75 - 125	0.00185		0.00008	U	0.00191	97		7470A
Nickel	75 - 125	0.467		0.011		0.407	112		6010C
Silver	75 - 125	0.100		0.002	U	0.111	90		6010C
Zinc	75 - 125	1.362		0.946		0.366	114		6010C

An empty field in the Control Limit column indicates the control limit is not applicable

Simultaneouslv Extractable Metals

- 6 -

DUPLICATES

Client: Golder Associates, Inc. **Service Request:** K1704247

Project No.: 1657231 **Units:** UMOLE/G

Project Name: Skagway-Sediment 2017 **Basis:** DRY

Matrix: SEDIMENT **% Solids:** 75.3

Sample Name: SED17-05D **Lab Code:** K1704247-001D

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	Method
Antimony		0.006	U	0.006	U			6010C
Arsenic		0.010	U	0.010	U			6010C
Cadmium		0.0004		0.0005		22.2		6010C
Chromium		0.0118		0.0145		20.5		6010C
Copper	30	0.121		0.147		19.4		6010C
Lead	30	0.226		0.255		12.1		6010C
Mercury		0.00008	U	0.00008	U			7470A
Nickel	30	0.011		0.013		16.7		6010C
Silver		0.002	U	0.002	U			6010C
Zinc	30	0.946		1.177		21.8		6010C

An empty field in the Control Limit column indicates the control limit is not applicable.

Simultaneously Extractable Metals
- 7 -
LABORATORY CONTROL SAMPLE

Client: Golder Associates, Inc. **Service Request:** K1704247

Project No.: 1657231

Project Name: Skagway-Sediment 2017

Aqueous LCS Source: ALS MIXED **Solid LCS Source:**

Analyte	Aqueous (umol/L)			Solid (mg/kg)				
	True	Found	%R	True	Found	C	Limits	%R
Antimony	4.100	3.864	94					
Arsenic	33.400	33.318	100					
Cadmium	11.100	11.284	102					
Chromium	9.610	9.520	99					
Copper	9.830	9.373	95					
Lead	12.100	12.004	99					
Mercury	0.09960	0.09560	96					
Nickel	21.200	21.511	101					
Silver	5.790	5.466	94					
Zinc	19.100	19.896	104					

Diesel and Residual Range Organics

ALS Environmental—Kelso Laboratory
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www.alsglobal.com

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/25/2017
Sample Matrix:	Sediment	**Date Received:**	04/29/2017

Diesel and Residual Range Organics

Sample Name:	SED17-05	**Units:**	mg/Kg
Lab Code:	K1704247-001	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	27	1	05/09/17	05/16/17	KWG1703745	
C25 - C36 RRO	ND	U	140	1	05/09/17	05/16/17	KWG1703745	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	110	50-150	05/16/17	Acceptable
n-Triacontane	107	50-150	05/16/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/26/2017
Sample Matrix:	Sediment	**Date Received:**	04/29/2017

Diesel and Residual Range Organics

Sample Name:	SED17-08	**Units:**	mg/Kg
Lab Code:	K1704247-002	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	27	1	05/09/17	05/16/17	KWG1703745	
C25 - C36 RRO	ND	U	140	1	05/09/17	05/16/17	KWG1703745	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	125	50-150	05/16/17	Acceptable
n-Triacontane	122	50-150	05/16/17	Acceptable

Comments:

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Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/26/2017
Sample Matrix:	Sediment	**Date Received:**	04/29/2017

Diesel and Residual Range Organics

Sample Name:	SED17-06	**Units:**	mg/Kg
Lab Code:	K1704247-003	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	**36**	Z	26	1	05/09/17	05/16/17	KWG1703745	
C25 - C36 RRO	ND	U	130	1	05/09/17	05/16/17	KWG1703745	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	127	50-150	05/16/17	Acceptable
n-Triacontane	124	50-150	05/16/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA

Diesel and Residual Range Organics

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1703745-5	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	20	1	05/09/17	05/10/17	KWG1703745	
C25 - C36 RRO	ND	U	99	1	05/09/17	05/10/17	KWG1703745	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	74	50-150	05/10/17	Acceptable
n-Triacontane	80	50-150	05/10/17	Acceptable

Comments:

QA/QC Report

Client: Golder Associates, Inc. **Service Request:** K1704247
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Surrogate Recovery Summary
Diesel and Residual Range Organics

Extraction Method: EPA 3550B **Units:** Percent
Analysis Method: AK 102.0/103.0 **Level:** Low

Sample Name	Lab Code	Sur1	Sur2
SED17-05	K1704247-001	110	107
SED17-08	K1704247-002	125	122
SED17-06	K1704247-003	127	124
Method Blank	KWG1703745-5	74	80
SED17-05MS	KWG1703745-1	138	134
SED17-05DMS	KWG1703745-2	123	118
Lab Control Sample	KWG1703745-3	77	81
Duplicate Lab Control Sample	KWG1703745-4	94	99

Surrogate Recovery Control Limits (%)

Sur1	= o-Terphenyl	50-150
Sur2	= n-Triacontane	50-150

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Extracted:**	05/09/2017
Sample Matrix:	Sediment	**Date Analyzed:**	05/16/2017

Matrix Spike/Duplicate Matrix Spike Summary
Diesel and Residual Range Organics

Sample Name:	SED17-05	**Units:**	mg/Kg
Lab Code:	K1704247-001	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0	**Extraction Lot:**	KWG1703745

		SED17-05MS KWG1703745-1 **Matrix Spike**			SED17-05DMS KWG1703745-2 **Duplicate Matrix Spike**					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
C10 - C25 DRO	ND	466	353	132 *	412	351	118	75-125	12	20
C25 - C36 RRO	ND	254	176	144 *	226	175	129 *	60-120	12	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704247
Project:	Skagway-Sediment 2017/1657231	**Date Extracted:**	05/09/2017
Sample Matrix:	Sediment	**Date Analyzed:**	05/10/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Diesel and Residual Range Organics

Extraction Method:	EPA 3550B	**Units:**	mg/Kg
Analysis Method:	AK 102.0/103.0	**Basis:**	Dry
		Level:	Low
		Extraction Lot:	KWG1703745

	Lab Control Sample KWG1703745-3 **Lab Control Spike**			Duplicate Lab Control Sample KWG1703745-4 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
C10 - C25 DRO	199	267	75	243	267	91	75-125	20	20
C25 - C36 RRO	124	133	93	147	133	110	60-120	16	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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May 22, 2017

Analytical Report for Service Request No: K1704415

Tamra Reynolds
Golder Associates Ltd.
Suite 201C, 170 Titanium Way
Whitehorse, YT Y1A0G1

RE: Skagway-Sediment 2017 / 1657231

Dear Tamra,

Enclosed are the results of the sample(s) submitted to our laboratory May 04, 2017
For your reference, these analyses have been assigned our service request number **K1704415.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3364. You may also contact me via email at howard.holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Howard Holmes
Project Manager

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Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimated value.
J	The result is an estimated value.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	Not available	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	03016
Maine DHS	Not available	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
North Carolina DWQ	http://www.dwqlab.org/	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/envserv/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.

Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS Environmental—Kelso Laboratory
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ALS ENVIRONMENTAL

Client:	Golder Associates, Inc.	**Service Request No.:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Received:**	05/04/17
Sample Matrix:	Sediment		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt

Seven sediment samples were received for analysis at ALS Environmental on 05/04/17. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

Total Metals

Matrix Spike Recovery Exceptions:
The control criteria for matrix spike recovery of Aluminum, Calcium, Iron, Magnesium, Potassium, and Sodium for sample DUP-1 were not applicable. The analyte concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

Antimony recoveries are generally low for soil and sediment samples when digested using EPA Method 3050B. Despite anticipated low recoveries, the method is still generally prescribed because of its versatility for general metals analysis. Antimony results (in conjunction with the matrix spike recovery) from this procedure should only be used as indicators to estimate concentrations. The matrix spike recovery of Antimony for sample DUP-1 was below the ALS control criterion. Since low recoveries resulted from a method defect and were possibly magnified by certain matrix components, no corrective action was appropriate. Alternative procedures that specifically target Antimony are available but were not specified for this project. The associated QA/QC results (e.g. control sample, calibration standards, etc.) indicated the analysis was in control.

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for the replicate analysis of Cadmium and Calcium in sample DUP-1 was outside the normal ALS control limits. Standard mixing techniques were used, but were not sufficient for complete homogenization of this sample.

No other anomalies associated with the analysis of these samples were observed.

Approved by__________________________________

Polynuclear Aromatic Hydrocarbons by EPA Method 8270

Surrogate Exceptions:
The control criteria were exceeded for one or more surrogates in the replicate Matrix Spikes (MS/DMS) KWG1703683-1 and KWG1703683-2 of sample DUP1 due to matrix interferences. The presence of non-target background components prevented adequate resolution of the surrogates. Accurate quantitation was not possible. No further corrective action was appropriate.

Matrix Spike Recovery Exceptions:
The Matrix Spike (MS) KWG1703683-1 recovery of Fluoranthene for sample DUP1 was outside control criteria. Recoveries in the replicate Laboratory Control Samples (LCS/DLCS) KWG1703683-3 and KWG1703683-4 were acceptable, which indicated the analytical batch was in control. The matrix spike outlier suggested a potential high bias in this matrix. No further corrective action was appropriate.

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for Fluoranthene in the replicate Matrix Spikes (MS/DMS) KWG1703683-1 and KWG1703683-2 analyses of DUP1 was outside control criteria. The Relative Percent Difference for the analyte in question in the associated replicate Laboratory Control Samples (LCS/DLCS) KWG1703683-3 and KWG1703683-4 was within acceptance limits, indicating the analytical batch was in control. No further corrective action was appropriate.

No other anomalies associated with the analysis of these samples were observed.

Approved by____________________________________

Chain of Custody

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Phone (360)577-7222 Fax (360)636-1068
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K1704415

ALS Environmental
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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 - 594999

Page 1 of 1

Report To — Contact and company name below will appear on the final report

Company:	Golder Associates LTD
Contact:	Tamra Reynolds
Phone:	1-867-334-4468
Company address below will appear on the final report	
Street:	170 - 201C Titanium Way
City/Province:	Whitehorse, Yukon
Postal Code:	Y1A 0G1

Report Format / Distribution

Select Report Format: [x] PDF [x] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report [x] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: [x] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax TJREYNOLDS@golder.com
Email 2 PADDY_HCMAHUS@golder.com
Email 3 VMERCER@golder.com

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] [x] Standard TAT if received by 3 pm - business days - no surcharges apply
PRIORITY (Business Days): 4 day [P4] [x] 3 day [P3] [ ] 2 day [P2] [ ]
EMERGENCY: 1 Business day [E1] [ ] Same Day, Weekend or Statutory holiday [E0] [ ]
Date and Time Required for all E&P TATs:
For tests that can not be performed according to the service level selected, you will be contacted.

Invoice To
Same as Report To [x] YES [ ] NO
Copy of Invoice with Report [x] YES [ ] NO
Company:
Contact:

Invoice Distribution
Select Invoice Distribution: [x] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax same as report
Email 2

Project Information
ALS Account # / Quote #: 41037
Job #: 1657231
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)
AFE/Cost Center: PO#
Major/Minor Code: Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Payfair Sampler: PM/SM

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals	PAHs	Grainsize (GS)	Total Organic Carbon (TOC)	DRO	AVS/SEM	Number of Containers
	DUP-1	28-APR-17	18:00	sediment	X	X	X	X			4
	SED17-31	28-APR-17	18:00	↓	↓	↓	↓	↓			↓
	SED17-09	29-APR-17	19:00								
	SED17-13	29-APR-17	16:00								
	SED17-14	30-APR-17	16:00								
	SED17-11	30-APR-17	14:00								
	SED17-17	30-APR-17	18:00								

Drinking Water (DW) Samples[1] (client use)
Are samples taken from a Regulated DW System? [ ] YES [x] NO
Are samples for human drinking water use? [ ] YES [x] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Please archive unused samples. 5-day turnaround on metals and PAHs, regular turnaround on GS and TOC; wait for direction for DRO and AVS/SEM

SAMPLE CONDITION AS RECEIVED (lab use only)
Frozen [ ] SIF Observations Yes [ ] No [ ]
Ice Packs [ ] Ice Cubes [ ] Custody seal intact Yes [ ] No [ ]
Cooling Initiated [ ]
INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 1-MAY-17	Time: 7:00	Received by: Cody Cerwer	Date: 5/4/17 0940	Time:	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

PC HH

Cooler Receipt and Preservation Form

Client Golder Assc Service Request K17 04415

Received: 5/4/17 Opened: 5/4/17 By: [signature] Unloaded: 5/4/17 By: [signature]

1. Samples were received via? *USPS* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* ______ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where? One, front

   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
0.6	0.5	4.1	4.0	-0.1	376			✓

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* ______
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA Y N

   If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

RUSH

Notes, Discrepancies, & Resolutions:

7/25/16

Page ___ of ___

Total Solids

ALS Environmental—Kelso Laboratory
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Client: Golder Associates, Inc. **Service Request:** K1704415
Project: Skagway-Sediment 2017/1657231 **Date Collected:** 04/28/17 - 04/30/17
Sample Matrix: Sediment **Date Received:** 05/4/17

Analysis Method: 160.3 Modified **Units:** Percent
Prep Method: None **Basis:** As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
DUP-1	K1704415-001	**49.0**	-	1	05/04/17 17:14	
SED17-31	K1704415-002	**47.7**	-	1	05/04/17 17:14	
SED17-09	K1704415-003	**55.3**	-	1	05/04/17 17:14	
SED17-13	K1704415-004	**53.8**	-	1	05/04/17 17:14	
SED17-14	K1704415-005	**75.5**	-	1	05/04/17 17:14	
SED17-11	K1704415-006	**86.5**	-	1	05/04/17 17:14	
SED17-17	K1704415-007	**75.9**	-	1	05/04/17 17:14	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Batch QC	K1704400-001DUP	-	67.4	66.5	67.0	1	20	05/04/17
Batch QC	K1704405-001DUP	-	86.5	87.4	87.0	1	20	05/04/17
Batch QC	K1704427-001DUP	-	62.8	67.6	65.2	7	20	05/04/17
Batch QC	K1704427-011DUP	-	89.2	90.1	89.7	1	20	05/04/17
Batch QC	K1704427-021DUP	-	91.6	91.6	91.6	<1	20	05/04/17

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 5/5/2017 9:20:35 AM   Superset Reference:17-0000420679 rev 00

Metals

ALS Environmental—Kelso Laboratory
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www.alsglobal.com

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/17 18:00
Sample Matrix:	Sediment	**Date Received:**	05/04/17 09:40
Sample Name:	DUP-1	**Basis:**	Dry
Lab Code:	K1704415-001		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**19900**		mg/Kg	2.6	2	05/09/17 12:21	05/04/17	
Antimony	6020A	ND	U	mg/Kg	0.065	5	05/11/17 07:17	05/04/17	
Arsenic	6020A	**5.81**		mg/Kg	0.65	5	05/11/17 07:17	05/04/17	
Barium	6010C	**439**		mg/Kg	1.0	2	05/09/17 12:21	05/04/17	
Beryllium	6020A	**0.356**		mg/Kg	0.026	5	05/11/17 07:17	05/04/17	
Cadmium	6020A	**0.724**		mg/Kg	0.026	5	05/11/17 07:17	05/04/17	
Calcium	6010C	**13800**		mg/Kg	5.2	2	05/09/17 12:21	05/04/17	
Chromium	6020A	**22.3**		mg/Kg	0.26	5	05/11/17 07:17	05/04/17	
Cobalt	6020A	**10.5**		mg/Kg	0.026	5	05/11/17 07:17	05/04/17	
Copper	6020A	**17.6**		mg/Kg	0.13	5	05/11/17 07:17	05/04/17	
Iron	6010C	**37500**		mg/Kg	5.2	2	05/09/17 12:21	05/04/17	
Lead	6020A	**16.4**		mg/Kg	0.065	5	05/11/17 07:17	05/04/17	
Magnesium	6010C	**13200**		mg/Kg	2.6	2	05/09/17 12:21	05/04/17	
Manganese	6010C	**478**		mg/Kg	0.26	2	05/09/17 12:21	05/04/17	
Mercury	7471B	ND	U	mg/Kg	0.021	1	05/09/17 12:28	05/08/17	
Nickel	6020A	**12.2**		mg/Kg	0.26	5	05/11/17 07:17	05/04/17	
Potassium	6010C	**9370**		mg/Kg	52	2	05/09/17 12:21	05/04/17	
Selenium	6020A	ND	U	mg/Kg	1.3	5	05/11/17 07:17	05/04/17	
Silver	6020A	**0.226**		mg/Kg	0.026	5	05/11/17 07:17	05/04/17	
Sodium	6010C	**14100**		mg/Kg	52	2	05/09/17 12:21	05/04/17	
Thallium	6020A	**0.511**		mg/Kg	0.026	5	05/11/17 07:17	05/04/17	
Vanadium	6020A	**70.1**		mg/Kg	0.26	5	05/11/17 07:17	05/04/17	
Zinc	6010C	**114**		mg/Kg	1.3	2	05/09/17 12:21	05/04/17	

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/17 18:00
Sample Matrix:	Sediment	**Date Received:**	05/04/17 09:40
Sample Name:	SED17-31	**Basis:**	Dry
Lab Code:	K1704415-002		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**20500**		mg/Kg	2.7	2	05/09/17 12:40	05/04/17	
Antimony	6020A	ND	U	mg/Kg	0.068	5	05/11/17 07:35	05/04/17	
Arsenic	6020A	**5.65**		mg/Kg	0.68	5	05/11/17 07:35	05/04/17	
Barium	6010C	**450**		mg/Kg	1.1	2	05/09/17 12:40	05/04/17	
Beryllium	6020A	**0.415**		mg/Kg	0.027	5	05/11/17 07:35	05/04/17	
Cadmium	6020A	**0.564**		mg/Kg	0.027	5	05/11/17 07:35	05/04/17	
Calcium	6010C	**12200**		mg/Kg	5.4	2	05/09/17 12:40	05/04/17	
Chromium	6020A	**24.9**		mg/Kg	0.27	5	05/11/17 07:35	05/04/17	
Cobalt	6020A	**11.6**		mg/Kg	0.027	5	05/11/17 07:35	05/04/17	
Copper	6020A	**19.0**		mg/Kg	0.14	5	05/11/17 07:35	05/04/17	
Iron	6010C	**37800**		mg/Kg	5.4	2	05/09/17 12:40	05/04/17	
Lead	6020A	**17.2**		mg/Kg	0.068	5	05/11/17 07:35	05/04/17	
Magnesium	6010C	**13200**		mg/Kg	2.7	2	05/09/17 12:40	05/04/17	
Manganese	6010C	**492**		mg/Kg	0.27	2	05/09/17 12:40	05/04/17	
Mercury	7471B	ND	U	mg/Kg	0.021	1	05/09/17 12:38	05/08/17	
Nickel	6020A	**13.3**		mg/Kg	0.27	5	05/11/17 07:35	05/04/17	
Potassium	6010C	**9550**		mg/Kg	54	2	05/09/17 12:40	05/04/17	
Selenium	6020A	ND	U	mg/Kg	1.4	5	05/11/17 07:35	05/04/17	
Silver	6020A	**0.257**		mg/Kg	0.027	5	05/11/17 07:35	05/04/17	
Sodium	6010C	**14300**		mg/Kg	54	2	05/09/17 12:40	05/04/17	
Thallium	6020A	**0.508**		mg/Kg	0.027	5	05/11/17 07:35	05/04/17	
Vanadium	6020A	**77.5**		mg/Kg	0.27	5	05/11/17 07:35	05/04/17	
Zinc	6010C	**115**		mg/Kg	1.4	2	05/09/17 12:40	05/04/17	

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Superset Reference:

ALS Group USA, Corp.
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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/29/17 19:00
Sample Matrix:	Sediment	**Date Received:**	05/04/17 09:40
Sample Name:	SED17-09	**Basis:**	Dry
Lab Code:	K1704415-003		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**17400**		mg/Kg	2.2	2	05/09/17 12:43	05/04/17	
Antimony	6020A	**0.117**		mg/Kg	0.055	5	05/11/17 07:38	05/04/17	
Arsenic	6020A	**4.47**		mg/Kg	0.55	5	05/11/17 07:38	05/04/17	
Barium	6010C	**419**		mg/Kg	0.88	2	05/09/17 12:43	05/04/17	
Beryllium	6020A	**0.319**		mg/Kg	0.022	5	05/11/17 07:38	05/04/17	
Cadmium	6020A	**1.83**		mg/Kg	0.022	5	05/11/17 07:38	05/04/17	
Calcium	6010C	**11400**		mg/Kg	4.4	2	05/09/17 12:43	05/04/17	
Chromium	6020A	**18.6**		mg/Kg	0.22	5	05/11/17 07:38	05/04/17	
Cobalt	6020A	**9.18**		mg/Kg	0.022	5	05/11/17 07:38	05/04/17	
Copper	6020A	**93.5**		mg/Kg	0.11	5	05/11/17 07:38	05/04/17	
Iron	6010C	**33600**		mg/Kg	4.4	2	05/09/17 12:43	05/04/17	
Lead	6020A	**666**		mg/Kg	0.055	5	05/11/17 07:38	05/04/17	
Magnesium	6010C	**11400**		mg/Kg	2.2	2	05/09/17 12:43	05/04/17	
Manganese	6010C	**516**		mg/Kg	0.22	2	05/09/17 12:43	05/04/17	
Mercury	7471B	**0.821**		mg/Kg	0.017	1	05/09/17 12:40	05/08/17	
Nickel	6020A	**10.4**		mg/Kg	0.22	5	05/11/17 07:38	05/04/17	
Potassium	6010C	**8670**		mg/Kg	44	2	05/09/17 12:43	05/04/17	
Selenium	6020A	ND	U	mg/Kg	1.1	5	05/11/17 07:38	05/04/17	
Silver	6020A	**1.04**		mg/Kg	0.022	5	05/11/17 07:38	05/04/17	
Sodium	6010C	**11000**		mg/Kg	44	2	05/09/17 12:43	05/04/17	
Thallium	6020A	**0.432**		mg/Kg	0.022	5	05/11/17 07:38	05/04/17	
Vanadium	6020A	**64.0**		mg/Kg	0.22	5	05/11/17 07:38	05/04/17	
Zinc	6010C	**1040**		mg/Kg	1.1	2	05/09/17 12:43	05/04/17	

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Superset Reference:

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/29/17 16:00
Sample Matrix:	Sediment	**Date Received:**	05/04/17 09:40
Sample Name:	SED17-13	**Basis:**	Dry
Lab Code:	K1704415-004		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**21100**		mg/Kg	2.6	2	05/09/17 12:46	05/04/17	
Antimony	6020A	**0.147**		mg/Kg	0.066	5	05/11/17 07:42	05/04/17	
Arsenic	6020A	**4.29**		mg/Kg	0.66	5	05/11/17 07:42	05/04/17	
Barium	6010C	**474**		mg/Kg	1.1	2	05/09/17 12:46	05/04/17	
Beryllium	6020A	**0.384**		mg/Kg	0.026	5	05/11/17 07:42	05/04/17	
Cadmium	6020A	**1.51**		mg/Kg	0.026	5	05/11/17 07:42	05/04/17	
Calcium	6010C	**7670**		mg/Kg	5.3	2	05/09/17 12:46	05/04/17	
Chromium	6020A	**23.5**		mg/Kg	0.26	5	05/11/17 07:42	05/04/17	
Cobalt	6020A	**11.4**		mg/Kg	0.026	5	05/11/17 07:42	05/04/17	
Copper	6020A	**100**		mg/Kg	0.13	5	05/11/17 07:42	05/04/17	
Iron	6010C	**39600**		mg/Kg	5.3	2	05/09/17 12:46	05/04/17	
Lead	6020A	**666**		mg/Kg	0.066	5	05/11/17 07:42	05/04/17	
Magnesium	6010C	**13400**		mg/Kg	2.6	2	05/09/17 12:46	05/04/17	
Manganese	6010C	**535**		mg/Kg	0.26	2	05/09/17 12:46	05/04/17	
Mercury	7471B	**0.413**		mg/Kg	0.022	1	05/09/17 12:41	05/08/17	
Nickel	6020A	**12.9**		mg/Kg	0.26	5	05/11/17 07:42	05/04/17	
Potassium	6010C	**10100**		mg/Kg	53	2	05/09/17 12:46	05/04/17	
Selenium	6020A	ND	U	mg/Kg	1.3	5	05/11/17 07:42	05/04/17	
Silver	6020A	**1.05**		mg/Kg	0.026	5	05/11/17 07:42	05/04/17	
Sodium	6010C	**11900**		mg/Kg	53	2	05/09/17 12:46	05/04/17	
Thallium	6020A	**0.542**		mg/Kg	0.026	5	05/11/17 07:42	05/04/17	
Vanadium	6020A	**78.3**		mg/Kg	0.26	5	05/11/17 07:42	05/04/17	
Zinc	6010C	**642**		mg/Kg	1.3	2	05/09/17 12:46	05/04/17	

Client: Golder Associates, Inc.
Service Request: K1704415
Project: Skagway-Sediment 2017/1657231
Date Collected: 04/30/17 16:00
Sample Matrix: Sediment
Date Received: 05/04/17 09:40

Sample Name: SED17-14
Basis: Dry
Lab Code: K1704415-005

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**9690**		mg/Kg	1.7	2	05/09/17 12:48	05/04/17	
Antimony	6020A	ND	U	mg/Kg	0.043	5	05/11/17 07:53	05/04/17	
Arsenic	6020A	**2.06**		mg/Kg	0.43	5	05/11/17 07:53	05/04/17	
Barium	6010C	**224**		mg/Kg	0.68	2	05/09/17 12:48	05/04/17	
Beryllium	6020A	**0.198**		mg/Kg	0.017	5	05/11/17 07:53	05/04/17	
Cadmium	6020A	**0.394**		mg/Kg	0.017	5	05/11/17 07:53	05/04/17	
Calcium	6010C	**4410**		mg/Kg	3.4	2	05/09/17 12:48	05/04/17	
Chromium	6020A	**12.3**		mg/Kg	0.17	5	05/11/17 07:53	05/04/17	
Cobalt	6020A	**5.92**		mg/Kg	0.017	5	05/11/17 07:53	05/04/17	
Copper	6020A	**62.3**		mg/Kg	0.085	5	05/11/17 07:53	05/04/17	
Iron	6010C	**18700**		mg/Kg	3.4	2	05/09/17 12:48	05/04/17	
Lead	6020A	**144**		mg/Kg	0.043	5	05/11/17 07:53	05/04/17	
Magnesium	6010C	**6290**		mg/Kg	1.7	2	05/09/17 12:48	05/04/17	
Manganese	6010C	**259**		mg/Kg	0.17	2	05/09/17 12:48	05/04/17	
Mercury	7471B	**0.126**		mg/Kg	0.015	1	05/09/17 12:43	05/08/17	
Nickel	6020A	**6.30**		mg/Kg	0.17	5	05/11/17 07:53	05/04/17	
Potassium	6010C	**4530**		mg/Kg	34	2	05/09/17 12:48	05/04/17	
Selenium	6020A	ND	U	mg/Kg	0.85	5	05/11/17 07:53	05/04/17	
Silver	6020A	**0.209**		mg/Kg	0.017	5	05/11/17 07:53	05/04/17	
Sodium	6010C	**4500**		mg/Kg	34	2	05/09/17 12:48	05/04/17	
Thallium	6020A	**0.223**		mg/Kg	0.017	5	05/11/17 07:53	05/04/17	
Vanadium	6020A	**41.3**		mg/Kg	0.17	5	05/11/17 07:53	05/04/17	
Zinc	6010C	**212**		mg/Kg	0.85	2	05/09/17 12:48	05/04/17	

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704415
Date Collected: 04/30/17 14:00
Date Received: 05/04/17 09:40

Sample Name: SED17-11
Lab Code: K1704415-006

Basis: Dry

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**7210**		mg/Kg	1.9	2	05/09/17 12:51	05/04/17	
Antimony	6020A	ND	U	mg/Kg	0.048	5	05/11/17 07:56	05/04/17	
Arsenic	6020A	**1.48**		mg/Kg	0.48	5	05/11/17 07:56	05/04/17	
Barium	6010C	**139**		mg/Kg	0.77	2	05/09/17 12:51	05/04/17	
Beryllium	6020A	**0.153**		mg/Kg	0.019	5	05/11/17 07:56	05/04/17	
Cadmium	6020A	**0.197**		mg/Kg	0.019	5	05/11/17 07:56	05/04/17	
Calcium	6010C	**3210**		mg/Kg	3.8	2	05/09/17 12:51	05/04/17	
Chromium	6020A	**9.68**		mg/Kg	0.19	5	05/11/17 07:56	05/04/17	
Cobalt	6020A	**4.39**		mg/Kg	0.019	5	05/11/17 07:56	05/04/17	
Copper	6020A	**48.0**		mg/Kg	0.096	5	05/11/17 07:56	05/04/17	
Iron	6010C	**15700**		mg/Kg	3.8	2	05/09/17 12:51	05/04/17	
Lead	6020A	**85.0**		mg/Kg	0.048	5	05/11/17 07:56	05/04/17	
Magnesium	6010C	**4810**		mg/Kg	1.9	2	05/09/17 12:51	05/04/17	
Manganese	6010C	**221**		mg/Kg	0.19	2	05/09/17 12:51	05/04/17	
Mercury	7471B	**0.077**		mg/Kg	0.020	1	05/09/17 12:45	05/08/17	
Nickel	6020A	**4.16**		mg/Kg	0.19	5	05/11/17 07:56	05/04/17	
Potassium	6010C	**2900**		mg/Kg	38	2	05/09/17 12:51	05/04/17	
Selenium	6020A	ND	U	mg/Kg	0.96	5	05/11/17 07:56	05/04/17	
Silver	6020A	**0.126**		mg/Kg	0.019	5	05/11/17 07:56	05/04/17	
Sodium	6010C	**2370**		mg/Kg	38	2	05/09/17 12:51	05/04/17	
Thallium	6020A	**0.143**		mg/Kg	0.019	5	05/11/17 07:56	05/04/17	
Vanadium	6020A	**30.0**		mg/Kg	0.19	5	05/11/17 07:56	05/04/17	
Zinc	6010C	**125**		mg/Kg	0.96	2	05/09/17 12:51	05/04/17	

Client: Golder Associates, Inc. **Service Request:** K1704415
Project: Skagway-Sediment 2017/1657231 **Date Collected:** 04/30/17 18:00
Sample Matrix: Sediment **Date Received:** 05/04/17 09:40

Sample Name: SED17-17 **Basis:** Dry
Lab Code: K1704415-007

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**10800**		mg/Kg	2.1	2	05/09/17 12:53	05/04/17	
Antimony	6020A	ND	U	mg/Kg	0.053	5	05/11/17 08:00	05/04/17	
Arsenic	6020A	**2.75**		mg/Kg	0.53	5	05/11/17 08:00	05/04/17	
Barium	6010C	**281**		mg/Kg	0.84	2	05/09/17 12:53	05/04/17	
Beryllium	6020A	**0.208**		mg/Kg	0.021	5	05/11/17 08:00	05/04/17	
Cadmium	6020A	**0.342**		mg/Kg	0.021	5	05/11/17 08:00	05/04/17	
Calcium	6010C	**6120**		mg/Kg	4.2	2	05/09/17 12:53	05/04/17	
Chromium	6020A	**13.4**		mg/Kg	0.21	5	05/11/17 08:00	05/04/17	
Cobalt	6020A	**6.65**		mg/Kg	0.021	5	05/11/17 08:00	05/04/17	
Copper	6020A	**37.1**		mg/Kg	0.11	5	05/11/17 08:00	05/04/17	
Iron	6010C	**22900**		mg/Kg	4.2	2	05/09/17 12:53	05/04/17	
Lead	6020A	**98.9**		mg/Kg	0.053	5	05/11/17 08:00	05/04/17	
Magnesium	6010C	**7330**		mg/Kg	2.1	2	05/09/17 12:53	05/04/17	
Manganese	6010C	**316**		mg/Kg	0.21	2	05/09/17 12:53	05/04/17	
Mercury	7471B	**0.143**		mg/Kg	0.022	1	05/09/17 12:46	05/08/17	
Nickel	6020A	**7.20**		mg/Kg	0.21	5	05/11/17 08:00	05/04/17	
Potassium	6010C	**6370**		mg/Kg	42	2	05/09/17 12:53	05/04/17	
Selenium	6020A	ND	U	mg/Kg	1.1	5	05/11/17 08:00	05/04/17	
Silver	6020A	**0.205**		mg/Kg	0.021	5	05/11/17 08:00	05/04/17	
Sodium	6010C	**3930**		mg/Kg	42	2	05/09/17 12:53	05/04/17	
Thallium	6020A	**0.254**		mg/Kg	0.021	5	05/11/17 08:00	05/04/17	
Vanadium	6020A	**44.6**		mg/Kg	0.21	5	05/11/17 08:00	05/04/17	
Zinc	6010C	**192**		mg/Kg	1.1	2	05/09/17 12:53	05/04/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ1705465-03		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	ND U	mg/Kg	2	2	05/09/17 12:17	05/04/17	
Antimony	6020A	ND U	mg/Kg	0.05	5	05/11/17 07:08	05/04/17	
Arsenic	6020A	ND U	mg/Kg	0.5	5	05/11/17 07:08	05/04/17	
Barium	6010C	ND U	mg/Kg	0.8	2	05/09/17 12:17	05/04/17	
Beryllium	6020A	ND U	mg/Kg	0.020	5	05/11/17 07:08	05/04/17	
Cadmium	6020A	ND U	mg/Kg	0.020	5	05/11/17 07:08	05/04/17	
Calcium	6010C	**5.2**	mg/Kg	4	2	05/09/17 12:17	05/04/17	
Chromium	6020A	ND U	mg/Kg	0.20	5	05/11/17 07:08	05/04/17	
Cobalt	6020A	ND U	mg/Kg	0.020	5	05/11/17 07:08	05/04/17	
Copper	6020A	ND U	mg/Kg	0.10	5	05/11/17 07:08	05/04/17	
Iron	6010C	**7.8**	mg/Kg	4	2	05/09/17 12:17	05/04/17	
Lead	6020A	ND U	mg/Kg	0.05	5	05/11/17 07:08	05/04/17	
Magnesium	6010C	ND U	mg/Kg	2	2	05/09/17 12:17	05/04/17	
Manganese	6010C	ND U	mg/Kg	0.2	2	05/09/17 12:17	05/04/17	
Nickel	6020A	ND U	mg/Kg	0.20	5	05/11/17 07:08	05/04/17	
Potassium	6010C	ND U	mg/Kg	40	2	05/09/17 12:17	05/04/17	
Selenium	6020A	ND U	mg/Kg	1.0	5	05/11/17 07:08	05/04/17	
Silver	6020A	ND U	mg/Kg	0.020	5	05/11/17 07:08	05/04/17	
Sodium	6010C	ND U	mg/Kg	40	2	05/09/17 12:17	05/04/17	
Thallium	6020A	ND U	mg/Kg	0.020	5	05/11/17 07:08	05/04/17	
Vanadium	6020A	ND U	mg/Kg	0.20	5	05/11/17 07:08	05/04/17	
Zinc	6010C	ND U	mg/Kg	1.0	2	05/09/17 12:17	05/04/17	

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ1705542-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Mercury	7471B	ND U	mg/Kg	0.02	1	05/09/17 12:25	05/08/17	

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/17
Sample Matrix:	Sediment	**Date Received:**	05/04/17
		Date Analyzed:	05/09/17 - 05/11/17

Replicate Sample Summary
Total Metals

Sample Name:	DUP-1	**Units:**	mg/Kg
Lab Code:	K1704415-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1705465-01 Result	Average	RPD	RPD Limit
Aluminum	6010C	2.7	19900	21400	20700	7	20
Antimony	6020A	0.068	ND U	ND U	ND	-	20
Arsenic	6020A	0.68	5.81	5.49	5.65	6	20
Barium	6010C	1.1	439	469	454	6	20
Beryllium	6020A	0.027	0.356	0.383	0.370	7	20
Cadmium	6020A	0.027	0.724	0.561	0.643	25 *	20
Calcium	6010C	5.4	13800	11300	12600	21 *	20
Chromium	6020A	0.27	22.3	23.1	22.7	4	20
Cobalt	6020A	0.027	10.5	10.9	10.7	3	20
Copper	6020A	0.14	17.6	18.4	18.0	4	20
Iron	6010C	5.4	37500	39100	38300	4	20
Lead	6020A	0.068	16.4	16.8	16.6	2	20
Magnesium	6010C	2.7	13200	13700	13500	4	20
Manganese	6010C	0.27	478	503	491	5	20
Nickel	6020A	0.27	12.2	12.4	12.3	1	20
Potassium	6010C	54	9370	9880	9630	5	20
Selenium	6020A	1.4	ND U	ND U	ND	-	20
Silver	6020A	0.027	0.226	0.216	0.221	4	20
Sodium	6010C	54	14100	14200	14200	<1	20
Thallium	6020A	0.027	0.511	0.479	0.495	6	20
Vanadium	6020A	0.27	70.1	72.8	71.5	4	20
Zinc	6010C	1.4	114	119	117	4	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 05/11/17 3:55:40 PM

Superset Reference:

QA/QC Report

Client: Golder Associates, Inc.
Project Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704415
Date Collected: 04/28/17
Date Received: 05/04/17
Date Analyzed: 05/09/17

Replicate Sample Summary
Total Metals

Sample Name: DUP-1
Lab Code: K1704415-001

Units: mg/Kg
Basis: Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1705542-03 Result	Average	RPD	RPD Limit
Mercury	7471B	0.021	ND U	ND U	ND	-	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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Superset Reference:

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/17
Sample Matrix:	Sediment	**Date Received:**	05/04/17
		Date Analyzed:	05/09/17 - 05/11/17

Matrix Spike Summary
Total Metals

Sample Name:	DUP-1	**Units:**	mg/Kg
Lab Code:	K1704415-001	**Basis:**	Dry

Matrix Spike
KQ1705465-02

Analyte Name	Method	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6010C	19900	21000	557	206 #	75-125
Antimony	6020A	ND U	31.1	139	22 N	75-125
Arsenic	6020A	5.81	144	139	99	75-125
Barium	6010C	439	733	278	106	75-125
Beryllium	6020A	0.356	13.5	13.9	95	75-125
Cadmium	6020A	0.724	15.1	13.9	103	75-125
Calcium	6010C	13800	16200	1390	170 #	75-125
Chromium	6020A	22.3	77.9	55.7	100	75-125
Cobalt	6020A	10.5	148	139	99	75-125
Copper	6020A	17.6	83.7	69.6	95	75-125
Iron	6010C	37500	37400	278	-11 #	75-125
Lead	6020A	16.4	149	139	95	75-125
Magnesium	6010C	13200	14700	1390	109 #	75-125
Manganese	6010C	478	612	139	96	75-125
Nickel	6020A	12.2	148	139	98	75-125
Potassium	6010C	9370	11000	1390	117 #	75-125
Selenium	6020A	ND U	137	139	99	75-125
Silver	6020A	0.226	14.2	13.9	101	75-125
Sodium	6010C	14100	16100	1390	145 #	75-125
Thallium	6020A	0.511	28.0	27.8	99	75-125
Vanadium	6020A	70.1	214	139	103	75-125
Zinc	6010C	114	241	139	91	75-125

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 05/11/17 3:55:40 PM Superset Reference:

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/17
Sample Matrix:	Sediment	**Date Received:**	05/04/17
		Date Analyzed:	05/9/17
		Date Extracted:	05/8/17

Matrix Spike Summary
Total Metals

Sample Name:	DUP-1	**Units:**	mg/Kg
Lab Code:	K1704415-001	**Basis:**	Dry
Analysis Method:	7471B		
Prep Method:	Method		

Matrix Spike
KQ1705542-04

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Mercury	ND U	0.590	0.549	108	80-120

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/09/17
Sample Matrix:	Sediment		

Lab Control Sample Summary
Total Metals

Units:mg/Kg
Basis: Dry

Lab Control Sample
KQ1705465-04

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6010C	7130	7930	90	39-161
Barium	6010C	331	308	107	74-126
Calcium	6010C	6730	6610	102	74-126
Iron	6010C	12700	14400	88	36-164
Magnesium	6010C	2680	2640	102	64-136
Manganese	6010C	422	410	103	76-124
Potassium	6010C	2560	2550	100	61-139
Sodium	6010C	3100	2480	125	65-173
Zinc	6010C	193	191	101	70-130

Client:	Golder Associates, Inc.		**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231		**Date Analyzed:**	05/11/17
Sample Matrix:	Sediment			

Lab Control Sample Summary
Total Metals

Units:mg/Kg
Basis: Dry

Lab Control Sample
KQ1705465-04

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Antimony	6020A	69.6	105	66	20-254
Arsenic	6020A	104	98.5	105	69-145
Beryllium	6020A	70.9	66.0	107	74-126
Cadmium	6020A	172	146	118	73-127
Chromium	6020A	198	182	109	71-130
Cobalt	6020A	187	162	116	74-125
Copper	6020A	116	106	109	75-125
Lead	6020A	139	130	107	72-127
Nickel	6020A	175	149	117	73-127
Selenium	6020A	170	154	110	68-132
Silver	6020A	45.1	40.9	110	66-134
Thallium	6020A	209	175	120	69-131
Vanadium	6020A	105	96.7	109	65-135

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/09/17
Sample Matrix:	Sediment		

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1705542-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Mercury	7471B	0.498	0.500	100	51-148

Polynuclear Aromatic Hydrocarbons

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
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www.alsglobal.com

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	DUP-1	**Units:**	ug/Kg
Lab Code:	K1704415-001	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	9.9	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	9.9	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	ND	U	9.9	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	9.9	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	ND	U	9.9	1	05/08/17	05/10/17	KWG1703683	
Fluorene	ND	U	9.9	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**12**		9.9	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**11**		9.9	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**58**		9.9	1	05/08/17	05/10/17	KWG1703683	
Pyrene	**78**		9.9	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**37**		9.9	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**37**		9.9	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**37**		9.9	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**16**		9.9	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**23**		9.9	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	ND	U	9.9	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	ND	U	9.9	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	**14**		9.9	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	87	38-104	05/10/17	Acceptable
Fluoranthene-d10	109	39-109	05/10/17	Acceptable
Terphenyl-d14	106	38-113	05/10/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-31	**Units:**	ug/Kg
Lab Code:	K1704415-002	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Fluorene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Anthracene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**49**		11	1	05/08/17	05/10/17	KWG1703683	
Pyrene	**60**		11	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**20**		11	1	05/08/17	05/10/17	KWG1703683	
Chrysene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**28**		11	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	ND	U	11	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	80	38-104	05/10/17	Acceptable
Fluoranthene-d10	103	39-109	05/10/17	Acceptable
Terphenyl-d14	100	38-113	05/10/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-09	**Units:**	ug/Kg
Lab Code:	K1704415-003	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	8.8	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	**9.4**		8.8	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	**73**		8.8	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	**55**		8.8	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	**27**		8.8	1	05/08/17	05/10/17	KWG1703683	
Fluorene	**89**		8.8	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**610**		8.8	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**260**		8.8	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**11000**	D	88	10	05/08/17	05/10/17	KWG1703683	
Pyrene	**9000**	D	88	10	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**2300**		8.8	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**2100**		8.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**2000**		8.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**680**		8.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**960**		8.8	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	**390**		8.8	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	**110**		8.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	**290**		8.8	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	84	38-104	05/10/17	Acceptable
Fluoranthene-d10	91	39-109	05/10/17	Acceptable
Terphenyl-d14	107	38-113	05/10/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-13	**Units:**	ug/Kg
Lab Code:	K1704415-004	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	9.1	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	**11**		9.1	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	**59**		9.1	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	**17**		9.1	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	**29**		9.1	1	05/08/17	05/10/17	KWG1703683	
Fluorene	**110**		9.1	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**470**		9.1	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**250**		9.1	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**2400**	D	91	10	05/08/17	05/10/17	KWG1703683	
Pyrene	**5700**	D	91	10	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**2200**		9.1	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**2200**		9.1	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**2500**		9.1	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**740**		9.1	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**1100**		9.1	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	**470**		9.1	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	**150**		9.1	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	**350**		9.1	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	75	38-104	05/10/17	Acceptable
Fluoranthene-d10	85	39-109	05/10/17	Acceptable
Terphenyl-d14	93	38-113	05/10/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/30/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-14	**Units:**	ug/Kg
Lab Code:	K1704415-005	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.4	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	6.4	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	**6.4**		6.4	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	6.4	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	ND	U	6.4	1	05/08/17	05/10/17	KWG1703683	
Fluorene	**9.6**		6.4	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**49**		6.4	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**28**		6.4	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**710**		6.4	1	05/08/17	05/10/17	KWG1703683	
Pyrene	**480**		6.4	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**180**		6.4	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**220**		6.4	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**180**		6.4	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**78**		6.4	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**79**		6.4	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	**34**		6.4	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	ND	U	6.4	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	**26**		6.4	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	75	38-104	05/10/17	Acceptable
Fluoranthene-d10	82	39-109	05/10/17	Acceptable
Terphenyl-d14	85	38-113	05/10/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/30/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-11	**Units:**	ug/Kg
Lab Code:	K1704415-006	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.8	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	5.8	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	ND	U	5.8	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	5.8	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	ND	U	5.8	1	05/08/17	05/10/17	KWG1703683	
Fluorene	ND	U	5.8	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**13**		5.8	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**7.9**		5.8	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**52**		5.8	1	05/08/17	05/10/17	KWG1703683	
Pyrene	**60**		5.8	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**88**		5.8	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**54**		5.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**140**		5.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**48**		5.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**50**		5.8	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	**18**		5.8	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	ND	U	5.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	**15**		5.8	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	70	38-104	05/10/17	Acceptable
Fluoranthene-d10	79	39-109	05/10/17	Acceptable
Terphenyl-d14	86	38-113	05/10/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/30/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-17	**Units:**	ug/Kg
Lab Code:	K1704415-007	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.4	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	6.4	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	ND	U	6.4	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	6.4	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	ND	U	6.4	1	05/08/17	05/10/17	KWG1703683	
Fluorene	**10**		6.4	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**51**		6.4	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**20**		6.4	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**180**		6.4	1	05/08/17	05/10/17	KWG1703683	
Pyrene	**110**		6.4	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**140**		6.4	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**150**		6.4	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**180**		6.4	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**72**		6.4	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**81**		6.4	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	**34**		6.4	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	**7.9**		6.4	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	**27**		6.4	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	79	38-104	05/10/17	Acceptable
Fluoranthene-d10	88	39-109	05/10/17	Acceptable
Terphenyl-d14	93	38-113	05/10/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Polynuclear Aromatic Hydrocarbons

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG1703683-5	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Fluorene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Anthracene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Pyrene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Chrysene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	72	38-104	05/10/17	Acceptable
Fluoranthene-d10	77	39-109	05/10/17	Acceptable
Terphenyl-d14	87	38-113	05/10/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Client: Golder Associates, Inc.
Service Request: K1704415
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Surrogate Recovery Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3546
Units: Percent
Analysis Method: 8270D SIM
Level: Low

Sample Name	Lab Code	Sur1	Sur2	Sur3
DUP-1	K1704415-001	87	109	106
SED17-31	K1704415-002	80	103	100
SED17-09	K1704415-003	84	91 D	107
SED17-13	K1704415-004	75	85 D	93
SED17-14	K1704415-005	75	82	85
SED17-11	K1704415-006	70	79	86
SED17-17	K1704415-007	79	88	93
Method Blank	KWG1703683-5	72	77	87
DUP-1MS	KWG1703683-1	86	113 *	107
DUP-1DMS	KWG1703683-2	90	118 *	114 *
Lab Control Sample	KWG1703683-3	76	87	89
Duplicate Lab Control Sample	KWG1703683-4	75	84	86

Surrogate Recovery Control Limits (%)

Sur1	=	Fluorene-d10	38-104
Sur2	=	Fluoranthene-d10	39-109
Sur3	=	Terphenyl-d14	38-113

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Extracted:**	05/08/2017
Sample Matrix:	Sediment	**Date Analyzed:**	05/10/2017

Matrix Spike/Duplicate Matrix Spike Summary
Polynuclear Aromatic Hydrocarbons

Sample Name:	DUP-1	**Units:**	ug/Kg
Lab Code:	K1704415-001	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM	**Extraction Lot:**	KWG1703683

		DUP-1MS KWG1703683-1 **Matrix Spike**			DUP-1DMS KWG1703683-2 **Duplicate Matrix Spike**					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	ND	751	1000	75	772	1010	77	29-88	3	40
2-Methylnaphthalene	ND	751	1000	75	785	1010	78	28-98	4	40
Acenaphthylene	ND	762	1000	76	793	1010	79	32-97	4	40
Acenaphthene	ND	791	1000	79	814	1010	81	30-101	3	40
Dibenzofuran	ND	811	1000	81	834	1010	83	28-105	3	40
Fluorene	ND	819	1000	82	864	1010	86	23-116	5	40
Phenanthrene	12	1150	1000	114	947	1010	93	10-128	19	40
Anthracene	11	853	1000	84	1030	1010	101	27-116	19	40
Fluoranthene	58	1790	1000	174 *	1110	1010	105	10-138	47 *	40
Pyrene	78	1380	1000	130	1050	1010	97	16-134	27	40
Benz(a)anthracene	37	948	1000	91	1000	1010	96	27-127	6	40
Chrysene	37	988	1000	95	1080	1010	103	25-132	9	40
Benzo(b)fluoranthene	37	1010	1000	97	1060	1010	102	21-130	5	40
Benzo(k)fluoranthene	16	967	1000	95	1010	1010	99	22-126	5	40
Benzo(a)pyrene	23	872	1000	85	955	1010	93	25-129	9	40
Indeno(1,2,3-cd)pyrene	ND	932	1000	93	987	1010	98	17-138	6	40
Dibenz(a,h)anthracene	ND	961	1000	96	1020	1010	102	32-116	6	40
Benzo(g,h,i)perylene	14	1010	1000	100	1050	1010	103	17-130	4	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp. dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704415
Project:	Skagway-Sediment 2017/1657231	**Date Extracted:**	05/08/2017
Sample Matrix:	Soil	**Date Analyzed:**	05/10/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method:	EPA 3546	**Units:**	ug/Kg
Analysis Method:	8270D SIM	**Basis:**	Dry
		Level:	Low
		Extraction Lot:	KWG1703683

	Lab Control Sample KWG1703683-3 **Lab Control Spike**			Duplicate Lab Control Sample KWG1703683-4 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	356	500	71	373	500	75	42-88	5	40
2-Methylnaphthalene	358	500	72	373	500	75	43-92	4	40
Acenaphthylene	359	500	72	382	500	76	44-93	6	40
Acenaphthene	361	500	72	385	500	77	44-95	6	40
Dibenzofuran	366	500	73	388	500	78	44-96	6	40
Fluorene	364	500	73	386	500	77	45-98	6	40
Phenanthrene	371	500	74	389	500	78	41-99	5	40
Anthracene	376	500	75	394	500	79	46-100	5	40
Fluoranthene	399	500	80	412	500	82	49-102	3	40
Pyrene	392	500	78	406	500	81	48-104	4	40
Benz(a)anthracene	395	500	79	407	500	81	52-105	3	40
Chrysene	414	500	83	428	500	86	51-110	3	40
Benzo(b)fluoranthene	422	500	84	433	500	87	52-114	3	40
Benzo(k)fluoranthene	431	500	86	445	500	89	52-112	3	40
Benzo(a)pyrene	400	500	80	409	500	82	52-111	2	40
Indeno(1,2,3-cd)pyrene	379	500	76	382	500	76	44-117	1	40
Dibenz(a,h)anthracene	379	500	76	391	500	78	44-110	3	40
Benzo(g,h,i)perylene	417	500	83	426	500	85	45-107	2	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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June 01, 2017

Analytical Report for Service Request No: K1704419

Tamra Reynolds
Golder Associates Ltd.
Suite 201C, 170 Titanium Way
Whitehorse, YT Y1A0G1

RE: Skagway-Sediment 2017 / 1657231

Dear Tamra,

Enclosed are the results of the sample(s) submitted to our laboratory May 04, 2017
For your reference, these analyses have been assigned our service request number **K1704419.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3364. You may also contact me via email at howard.holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Howard Holmes
Project Manager

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Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimated value.
J	The result is an estimated value.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEH	http://dec.alaska.gov/eh/lab/cs/csapproval.htm	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	http://health.hawaii.gov/	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/page/la-lab-accreditation	03016
Maine DHS	http://www.maine.gov/dhhs/	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/enforcement/oqa.html	WA005
New York - DOH	https://www.wadsworth.org/regulatory/elap	12060
North Carolina DEQ	https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/EnvironmentalLabCertification/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water-	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

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ALS ENVIRONMENTAL

Client:	Golder Associates, Inc.	**Service Request No.:**	K1704419
Project:	Skagway - Sediment 2017/ 1657231	**Date Received:**	05/04/17
Sample Matrix:	Sediment		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt

Seven sediment samples were received for analysis at ALS Environmental on 05/04/17. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry Parameters

Acid-Volatile Sulfide by EPA Method 821/R-91-100:
The matrix spike recoveries for sample SED17-09 were outside control criteria because of suspected matrix interference. As a result of the interference, the results for this analyte contained a potential high bias. No further corrective action was taken.

No other anomalies associated with the analysis of these samples were observed.

Total Metals

No anomalies associated with the analysis of these samples were observed.

Diesel and Residual Range Organics by Method AK102/ AK103

The recovery of n-Triacontane and o-Terphenyl in Continuing Calibration Verification (CCV) KWG1704203-3 were outside the control criteria of ± 20% listed in the analytical report. The recovery of the analyte was within the 60-120% control criteria for surrogate recoveries in laboratory quality control samples specified in the AK102/103 method. No further corrective action was necessary.

No other anomalies associated with the analysis of these samples were observed.

Approved by____________________________

Chain of Custody

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

K1704419

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
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Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 - 594999

Page 1 of 1

Report To — Contact and company name below will appear on the final report

Company:	Golder Associates LTD
Contact:	Tamra Reynolds
Phone:	1-867-334-4468
Company address below will appear on the final report	
Street:	170 - 201C Titanium Way
City/Province:	Whitehorse, Yukon
Postal Code:	Y1A 0G1

Report Format / Distribution

Select Report Format: [x] PDF [x] EXCEL [ ] EDD (DIGITAL)

Quality Control (QC) Report with Report [x] YES [ ] NO

[ ] Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: [x] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax: TJREYNOLDS@golder.com

Email 2: PADDY_MCMAHON@golder.com

Email 3: VMERCER@golder.com

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] [x] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] [x]; 3 day [P3] [ ]; 2 day [P2] [ ]

EMERGENCY: 1 Business day [E1] [ ]; Same Day, Weekend or Statutory holiday [E0] [ ]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Invoice To

Same as Report To [x] YES [ ] NO

Copy of Invoice with Report [x] YES [ ] NO

Company:

Contact:

Invoice Distribution

Select Invoice Distribution: [x] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax: same as report

Email 2:

Project Information

ALS Account # / Quote #: 41037

Job #: 1657231

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#

Major/Minor Code: | Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Payfair

Sampler: PM/SM

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals	PAHs	Grainsize (GS)	Total Organic Carbon (TOC)	DRO	AVS/SEM	Number of Containers
	DUP-1	28-APR-17	18:00	sediment	X	X	X	X			4
	SED17-31	28-APR-17	18:00								
	SED17-09	29-APR-17	19:00								
	SED17-13	29-APR-17	16:00								
	SED17-14	30-APR-17	16:00								
	SED17-11	30-APR-17	14:00								
	SED15-17	30-APR-17	18:00								

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [x] NO

Are samples for human drinking water use? [ ] YES [x] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Please archive unused samples. 5-day turnaround on metals and PAHs, regular turnaround on GS and TOC. Wait for direction for DRO and AVS/SEM

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [ ]

Ice Packs [ ] Ice Cubes [ ] Custody seal intact Yes [ ] No [ ]

Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 1-MAY-17	Time: 7:00	Received by: [signature]	Date: 5/4/17	Time: 0940	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

[1] If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS

PC HH

Cooler Receipt and Preservation Form

Client Golder Assc. Service Request K17 04419

Received: 5/4/17 Opened: 5/4/17 By: [signature] Unloaded: 5/4/17 By: [signature]

1. Samples were received via? *USPS* *Fed Ex* *UPS* *DHL* *PDX* ***Courier*** *Hand Delivered*
2. Samples were received in: (circle) ***Cooler*** *Box* *Envelope* *Other* ______ *NA*
3. Were custody seals on coolers? NA **Y** N If yes, how many and where? One, front
   If present, were custody seals intact? **Y** N If present, were they signed and dated? **Y** N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
0.6	0.5	4.1	4.0	-0.1	376			✓

4. Packing material: *Inserts* *Baggies* ***Bubble Wrap*** ***Gel Packs*** *Wet Ice* *Dry Ice* *Sleeves* ______
5. Were custody papers properly filled out (ink, signed, etc.)? NA **Y** N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA **Y** N
   If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA **Y** N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA **Y** N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA **Y** N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* **NA** Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* **NA** Y N
12. Was C12/Res negative? **NA** Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: RUSH

7/25/16 ***Page*** ____ ***of*** ____

Total Solids

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/17 - 04/30/17
Sample Matrix:	Sediment	**Date Received:**	05/4/17
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
DUP-1	K1704419-001	**46.1**	-	1	05/05/17 17:28	
SED17-31	K1704419-002	**46.8**	-	1	05/05/17 17:28	
SED17-09	K1704419-003	**57.3**	-	1	05/05/17 17:28	
SED17-13	K1704419-004	**53.6**	-	1	05/05/17 17:28	
SED17-14	K1704419-005	**74.1**	-	1	05/05/17 17:28	
SED17-11	K1704419-006	**80.8**	-	1	05/05/17 17:28	
SED17-17	K1704419-007	**75.6**	-	1	05/05/17 17:28	

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QA/QC Report

Client: | **Service Request:** KQ1705502
Project | **Date Collected:** NA
Sample Matrix: Sediment | **Date Received:** NA

Analysis Method: 160.3 Modified | **Units:** Percent
Prep Method: None | **Basis:** As Received

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Duplicate	K1704419-003DUP	-		57.2	57.3	<1	20	05/05/17
Batch QC	K1704473-006DUP	-	59.5	59.5	59.5	<1	20	05/05/17
Batch QC	K1704476-002DUP	-	81.4	85.3	83.4	5	20	05/05/17

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 5/8/2017 9:28:30 AM | Superset Reference:17-0000420868 rev 00

General Chemistry

ALS Environmental—Kelso Laboratory
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Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/29/17 - 04/30/17
Sample Matrix:	Sediment	**Date Received:**	05/4/17
Analysis Method:	821/R-91-100	**Units:**	uMole/g
Prep Method:	Method	**Basis:**	Dry

Sulfide, Acid-Volatile

Sample Name	Lab Code	Result		MRL	Dil.	Date Analyzed	Date Extracted	Q
SED17-09	K1704419-003	**8.39**		0.99	20	05/12/17 23:43	5/12/17	
SED17-13	K1704419-004	**5.5**		1.1	20	05/12/17 23:43	5/12/17	
SED17-14	K1704419-005	**0.088**		0.041	1	05/12/17 23:43	5/12/17	
SED17-11	K1704419-006	**0.043**		0.032	1	05/12/17 23:43	5/12/17	
SED17-17	K1704419-007	ND	U	0.037	1	05/12/17 23:43	5/12/17	
Method Blank	K1704419-MB	ND	U	0.016	1	05/12/17 23:43	5/12/17	

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Sediment	**Date Received:**	05/04/17
		Date Analyzed:	05/12/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	SED17-09	**Units:**	uMole/g
Lab Code:	K1704419-003	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1704419-003DUP Result	Average	RPD	RPD Limit
Sulfide, Acid-Volatile	821/R-91-100	0.97	8.39	8.82	8.61	5	45

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Sediment	**Date Received:**	05/04/17
		Date Analyzed:	05/12/17
		Date Extracted:	05/12/17

Duplicate Matrix Spike Summary
Sulfide, Acid-Volatile

Sample Name:	SED17-09	**Units:**	uMole/g
Lab Code:	K1704419-003	**Basis:**	Dry
Analysis Method:	821/R-91-100		
Prep Method:	Method		

		Matrix Spike K1704419-003MS			Duplicate Matrix Spike K1704419-003DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Sulfide, Acid-Volatile	8.39	61.8	35.3	151 *	63.2	35.6	154 *	56-142	2	45

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/12/17
Sample Matrix:	Sediment	**Date Extracted:**	05/12/17

Lab Control Sample Summary
Sulfide, Acid-Volatile

Analysis Method:	821/R-91-100	**Units:**	uMole/g
Prep Method:	Method	**Basis:**	Dry
		Analysis Lot:	545571

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1704419-LCS	0.210	0.228	92	60-115

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	4/28/2017
Sample Matrix:	Sediment	**Date Received:**	5/4/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: DUP-1
Lab Code: K1704419-001

Sand Fraction: Weight (Grams)	1.8905
Sand Fraction: Weight Recovered (Grams)	1.8779
Sand Fraction: Percent Recovery	99.34

Weight as received (Grams)	35.97
Percent Solids	46.1
Weight Oven-Dried (Grams)	16.5822

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.0177	0.11
Gravel, Fine	2.00 mm	10	0.2936	1.77
Sand, Very Coarse	0.850 mm	20	0.3895	2.35
Sand, Coarse	0.425 mm	40	0.2301	1.39
Sand, Medium	0.250 mm	60	0.2109	1.27
Sand, Fine	0.106 mm	140	0.3595	2.17
Sand, Very Fine	0.075 mm	200	0.2859	1.72
Silt			12.0600	72.73
Clay			2.9850	18.00
		Total	16.8322	101.51

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	4/28/2017
Sample Matrix:	Sediment	**Date Received:**	5/4/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-31
Lab Code: K1704419-002

Sand Fraction: Weight (Grams)	1.8775
Sand Fraction: Weight Recovered (Grams)	1.8466
Sand Fraction: Percent Recovery	98.35

Weight as received (Grams)	30.726
Percent Solids	46.8
Weight Oven-Dried (Grams)	14.3798

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.1682	1.17
Gravel, Fine	2.00 mm	10	0.5095	3.54
Sand, Very Coarse	0.850 mm	20	0.3092	2.15
Sand, Coarse	0.425 mm	40	0.1860	1.29
Sand, Medium	0.250 mm	60	0.1512	1.05
Sand, Fine	0.106 mm	140	0.2662	1.85
Sand, Very Fine	0.075 mm	200	0.2012	1.40
Silt			9.2350	64.22
Clay			3.1750	22.08
		Total	14.2015	98.75

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	4/29/2017
Sample Matrix:	Sediment	**Date Received:**	5/4/2017
		Date Analyzed:	5/8/2017

Particle Size Determination

ASTM D422M

Sample Name: SED17-09

Lab Code: K1704419-003

Sand Fraction: Weight (Grams)	6.0532
Sand Fraction: Weight Recovered (Grams)	5.9124
Sand Fraction: Percent Recovery	97.67

Weight as received (Grams)	36.877
Percent Solids	57.3
Weight Oven-Dried (Grams)	21.1305

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.0618	0.29
Gravel, Fine	2.00 mm	10	0.0797	0.38
Sand, Very Coarse	0.850 mm	20	0.3424	1.62
Sand, Coarse	0.425 mm	40	0.8824	4.18
Sand, Medium	0.250 mm	60	1.0183	4.82
Sand, Fine	0.106 mm	140	2.1304	10.08
Sand, Very Fine	0.075 mm	200	1.0409	4.93
Silt			11.6300	55.04
Clay			3.1600	14.95
		Total	20.3459	96.29

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	4/29/2017
Sample Matrix:	Sediment	**Date Received:**	5/4/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-13
Lab Code: K1704419-004

Sand Fraction: Weight (Grams)	2.8216
Sand Fraction: Weight Recovered (Grams)	2.7950
Sand Fraction: Percent Recovery	99.06

Weight as received (Grams)	34.504
Percent Solids	53.6
Weight Oven-Dried (Grams)	18.4941

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.0000	0.00
Gravel, Fine	2.00 mm	10	0.0757	0.41
Sand, Very Coarse	0.850 mm	20	0.0968	0.52
Sand, Coarse	0.425 mm	40	0.1722	0.93
Sand, Medium	0.250 mm	60	0.2609	1.41
Sand, Fine	0.106 mm	140	1.2640	6.83
Sand, Very Fine	0.075 mm	200	0.7769	4.20
Silt			12.5500	67.86
Clay			3.4250	18.52
		Total	18.6215	100.68

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	4/30/2017
Sample Matrix:	Sediment	**Date Received:**	5/4/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-14
Lab Code: K1704419-005

Sand Fraction: Weight (Grams)	31.5780
Sand Fraction: Weight Recovered (Grams)	31.5668
Sand Fraction: Percent Recovery	99.96

Weight as received (Grams)	61.826
Percent Solids	74.1
Weight Oven-Dried (Grams)	45.8131

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.3433	0.75
Gravel, Fine	2.00 mm	10	0.3756	0.82
Sand, Very Coarse	0.850 mm	20	1.7894	3.91
Sand, Coarse	0.425 mm	40	7.0710	15.43
Sand, Medium	0.250 mm	60	9.0659	19.79
Sand, Fine	0.106 mm	140	10.1180	22.09
Sand, Very Fine	0.075 mm	200	2.2068	4.82
Silt			9.0950	19.85
Clay			5.4000	11.79
		Total	45.4650	99.25

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	4/30/2017
Sample Matrix:	Sediment	**Date Received:**	5/4/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-11
Lab Code: K1704419-006

Sand Fraction: Weight (Grams)	26.1464
Sand Fraction: Weight Recovered (Grams)	25.9451
Sand Fraction: Percent Recovery	99.23

Weight as received (Grams)	42.967
Percent Solids	80.8
Weight Oven-Dried (Grams)	34.7173

Description	**Sieve Size**	**Sieve Number**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	4.75 mm	4	1.7671	5.09
Gravel, Fine	2.00 mm	10	2.2919	6.60
Sand, Very Coarse	0.850 mm	20	5.1338	14.79
Sand, Coarse	0.425 mm	40	6.4526	18.59
Sand, Medium	0.250 mm	60	3.6962	10.65
Sand, Fine	0.106 mm	140	4.7630	13.72
Sand, Very Fine	0.075 mm	200	1.6188	4.66
Silt			4.8250	13.90
Clay			2.2550	6.50
		Total	32.8034	94.50

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	4/30/2017
Sample Matrix:	Sediment	**Date Received:**	5/4/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-17
Lab Code: K1704419-007

Sand Fraction: Weight (Grams)	15.1919
Sand Fraction: Weight Recovered (Grams)	15.0948
Sand Fraction: Percent Recovery	99.36

Weight as received (Grams)	38.952
Percent Solids	75.6
Weight Oven-Dried (Grams)	29.4477

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.0000	0.00
Gravel, Fine	2.00 mm	10	0.4569	1.55
Sand, Very Coarse	0.850 mm	20	0.8445	2.87
Sand, Coarse	0.425 mm	40	2.0237	6.87
Sand, Medium	0.250 mm	60	2.8773	9.77
Sand, Fine	0.106 mm	140	6.2528	21.23
Sand, Very Fine	0.075 mm	200	2.2501	7.64
Silt			8.4850	28.81
Clay			4.2450	14.42
		Total	27.4353	93.16

ALS Group USA, Corp.

dba ALS Environmental

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	4/28/2017
Sample Matrix:	Sediment	**Date Received:**	5/4/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: DUP-1
Lab Code: K1704419-001DUP

Sand Fraction: Weight (Grams)	1.6546
Sand Fraction: Weight Recovered (Grams)	1.6501
Sand Fraction: Percent Recovery	99.73

Weight as received (Grams)	29.357
Percent Solids	46.1
Weight Oven-Dried (Grams)	13.5336

Description	**Sieve Size**	**Sieve Number**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	4.75 mm	4	0.0201	0.15
Gravel, Fine	2.00 mm	10	0.3052	2.26
Sand, Very Coarse	0.850 mm	20	0.3711	2.74
Sand, Coarse	0.425 mm	40	0.2062	1.52
Sand, Medium	0.250 mm	60	0.1665	1.23
Sand, Fine	0.106 mm	140	0.2820	2.08
Sand, Very Fine	0.075 mm	200	0.1915	1.41
Silt			8.7600	64.73
Clay			3.2400	23.94
		Total	13.5426	100.06

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/17 - 04/30/17
Sample Matrix:	Sediment	**Date Received:**	05/4/17
Analysis Method:	Walkley-Black	**Units:**	mg/Kg
Prep Method:	None	**Basis:**	Dry

Carbon, Total Organic

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
DUP-1	K1704419-001	**25300**	4200	1	05/10/17 14:00	
SED17-31	K1704419-002	**21500**	4100	1	05/10/17 14:00	
SED17-09	K1704419-003	**8100**	3500	1	05/10/17 14:00	
SED17-13	K1704419-004	**9700**	3700	1	05/10/17 14:00	
SED17-14	K1704419-005	ND U	2500	1	05/10/17 14:00	
SED17-11	K1704419-006	ND U	2300	1	05/10/17 14:00	
SED17-17	K1704419-007	**3200**	2600	1	05/10/17 14:00	
Method Blank	K1704419-MB	ND U	2000	1	05/10/17 14:00	

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/17
Sample Matrix:	Sediment	**Date Received:**	05/04/17
		Date Analyzed:	05/10/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	DUP-1	**Units:**	mg/Kg
Lab Code:	K1704419-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1704419-001DUP Result	Average	RPD	RPD Limit
Carbon, Total Organic	Walkley-Black	4200	25300	24700	25000	2	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/10/17
Sample Matrix:	Sediment	**Date Extracted:**	NA

Lab Control Sample Summary
Carbon, Total Organic

Analysis Method:	Walkley-Black	**Units:**	mg/Kg
Prep Method:	None	**Basis:**	Dry
		Analysis Lot:	544533

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1704419-LCS	6000	5400	110	85-115

Metals

ALS Environmental—Kelso Laboratory
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Simultaneously Extractable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704419
Project No.: 1657231
Date Collected: 4/29/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/4/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-09
Lab Code: K1704419-003

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.009	1.0	05/12/17	05/17/17	0.009	U	
Arsenic	6010C	0.015	1.0	05/12/17	05/17/17	0.015	U	
Cadmium	6010C	0.0006	1.0	05/12/17	05/17/17	0.0022		
Chromium	6010C	0.006	1.0	05/12/17	05/17/17	0.028		
Copper	6010C	0.006	1.0	05/12/17	05/17/17	0.122		
Lead	6010C	0.003	1.0	05/12/17	05/17/17	0.706		
Mercury	7470A	0.00012	4.0	05/12/17	05/18/17	0.00012	U	
Nickel	6010C	0.003	1.0	05/12/17	05/17/17	0.029		
Silver	6010C	0.003	1.0	05/12/17	05/17/17	0.003	U	
Zinc	6010C	0.009	1.0	05/12/17	05/17/17	1.280		

% Solids: 57.3

Comments:

Simultaneously Extractable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704419
Project No.: 1657231
Date Collected: 4/29/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/4/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-13
Lab Code: K1704419-004

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.010	1.0	05/12/17	05/17/17	0.010	U	
Arsenic	6010C	0.017	1.0	05/12/17	05/17/17	0.017	U	
Cadmium	6010C	0.0007	1.0	05/12/17	05/17/17	0.0016		
Chromium	6010C	0.007	1.0	05/12/17	05/17/17	0.021		
Copper	6010C	0.007	1.0	05/12/17	05/17/17	0.369		
Lead	6010C	0.003	1.0	05/12/17	05/17/17	0.940		
Mercury	7470A	0.00014	4.0	05/12/17	05/18/17	0.00014	U	
Nickel	6010C	0.003	1.0	05/12/17	05/17/17	0.020		
Silver	6010C	0.003	1.0	05/12/17	05/17/17	0.003	U	
Zinc	6010C	0.010	1.0	05/12/17	05/17/17	1.730		

% Solids: 53.6

Comments:

Simultaneously Extractable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704419
Project No.: 1657231
Date Collected: 4/30/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/4/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-14
Lab Code: K1704419-005

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.008	1.0	05/12/17	05/17/17	0.008	U	
Arsenic	6010C	0.013	1.0	05/12/17	05/17/17	0.013	U	
Cadmium	6010C	0.0005	1.0	05/12/17	05/17/17	0.0005	U	
Chromium	6010C	0.005	1.0	05/12/17	05/17/17	0.017		
Copper	6010C	0.005	1.0	05/12/17	05/17/17	0.113		
Lead	6010C	0.003	1.0	05/12/17	05/17/17	0.286		
Mercury	7470A	0.00010	4.0	05/12/17	05/18/17	0.00010	U	
Nickel	6010C	0.003	1.0	05/12/17	05/17/17	0.013		
Silver	6010C	0.003	1.0	05/12/17	05/17/17	0.003	U	
Zinc	6010C	0.008	1.0	05/12/17	05/17/17	0.575		

% Solids: 74.1

Comments:

Simultaneously Extractable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704419
Project No.: 1657231
Date Collected: 4/30/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/4/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-11
Lab Code: K1704419-006

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.006	1.0	05/12/17	05/17/17	0.006	U	
Arsenic	6010C	0.010	1.0	05/12/17	05/17/17	0.010	U	
Cadmium	6010C	0.0004	1.0	05/12/17	05/17/17	0.0005		
Chromium	6010C	0.004	1.0	05/12/17	05/17/17	0.014		
Copper	6010C	0.004	1.0	05/12/17	05/17/17	0.091		
Lead	6010C	0.002	1.0	05/12/17	05/17/17	0.253		
Mercury	7470A	0.00008	4.0	05/12/17	05/18/17	0.00008	U	
Nickel	6010C	0.002	1.0	05/12/17	05/17/17	0.011		
Silver	6010C	0.002	1.0	05/12/17	05/17/17	0.002	U	
Zinc	6010C	0.006	1.0	05/12/17	05/17/17	0.724		

% Solids: 80.8

Comments:

Simultaneously Extractable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704419
Project No.: 1657231
Date Collected: 4/30/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/4/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-17 **Lab Code:** K1704419-007

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.007	1.0	05/12/17	05/17/17	0.007	U	
Arsenic	6010C	0.011	1.0	05/12/17	05/17/17	0.011	U	
Cadmium	6010C	0.0005	1.0	05/12/17	05/17/17	0.0005	U	
Chromium	6010C	0.005	1.0	05/12/17	05/17/17	0.014		
Copper	6010C	0.005	1.0	05/12/17	05/17/17	0.095		
Lead	6010C	0.002	1.0	05/12/17	05/17/17	0.222		
Mercury	7470A	0.00009	4.0	05/12/17	05/18/17	0.00009	U	
Nickel	6010C	0.002	1.0	05/12/17	05/17/17	0.012		
Silver	6010C	0.002	1.0	05/12/17	05/17/17	0.002	U	
Zinc	6010C	0.007	1.0	05/12/17	05/17/17	0.674		

% Solids: 75.6

Comments:

Simultaneously Extractable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704419
Project No.: 1657231
Date Collected:
Project Name: Skagway-Sediment 2017
Date Received:
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: Method Blank **Lab Code:** K1704419-MB

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.003	1.0	05/12/17	05/17/17	0.003	U	
Arsenic	6010C	0.005	1.0	05/12/17	05/17/17	0.005	U	
Cadmium	6010C	0.0002	1.0	05/12/17	05/17/17	0.0002	U	
Chromium	6010C	0.002	1.0	05/12/17	05/17/17	0.002	U	
Copper	6010C	0.002	1.0	05/12/17	05/17/17	0.002	U	
Lead	6010C	0.001	1.0	05/12/17	05/17/17	0.001	U	
Nickel	6010C	0.001	1.0	05/12/17	05/17/17	0.001	U	
Silver	6010C	0.001	1.0	05/12/17	05/17/17	0.001	U	
Zinc	6010C	0.003	1.0	05/12/17	05/17/17	0.003	U	

% Solids: 100.0

Comments:

Simultaneously Extractable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project No.:	1657231	**Date Collected:**	
Project Name:	Skagway-Sediment 2017	**Date Received:**	
Matrix:	SEDIMENT	**Units:**	umol/g
		Basis:	DRY

Sample Name: Method Blank **Lab Code:** KQ1705983-01

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Mercury	7470A	0.00004	4.0	05/12/17	05/18/17	0.00004	U	

% Solids: 100.0

Comments:

Simultaneously Extractable Metals

- 5A -

SPIKE SAMPLE RECOVERY

Client: Golder Associates, Inc.　　**Service Request:** K1704419

Project No.: 1657231　　**Units:** UMOLE/G

Project Name: Skagway-Sediment 2017　　**Basis:** DRY

Matrix: SEDIMENT　　**% Solids:** 57.3

Sample Name: **SED17-09S**　　**Lab Code:** **K1704419-003S**

Analyte	Control Limit %R	Spike Result	C	Sample Result	C	Spike Added	%R	Q	Method
Antimony	75 - 125	0.112		0.009	U	0.127	88		6010C
Arsenic	75 - 125	0.978		0.015	U	1.031	95		6010C
Cadmium	75 - 125	0.3841		0.0022		0.343	111		6010C
Chromium	75 - 125	0.3294		0.0277		0.297	102		6010C
Copper	75 - 125	0.380		0.122		0.304	85		6010C
Lead	75 - 125	1.097		0.706		0.374	105		6010C
Mercury	75 - 125	0.00315		0.00012	U	0.00308	102		7470A
Nickel	75 - 125	0.776		0.029		0.655	114		6010C
Silver	75 - 125	0.160		0.003	U	0.179	89		6010C
Zinc	75 - 125	1.889		1.275		0.590	104		6010C

An empty field in the Control Limit column indicates the control limit is not applicable

Simultaneouslv Extractable Metals

- 6 -
DUPLICATES

Client: Golder Associates, Inc. **Service Request:** K1704419

Project No.: 1657231 **Units:** UMOLE/G

Project Name: Skagway-Sediment 2017 **Basis:** DRY

Matrix: SEDIMENT **% Solids:** 57.3

Sample Name: **SED17-09D** **Lab Code:** **K1704419-003D**

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	Method
Antimony		0.009	U	0.009	U			6010C
Arsenic		0.015	U	0.015	U			6010C
Cadmium		0.0022		0.0018		20.0		6010C
Chromium		0.0277		0.0244		12.7		6010C
Copper	30	0.122		0.095		24.9		6010C
Lead	30	0.706		0.607		15.1		6010C
Mercury		0.00012	U	0.00012	U			7470A
Nickel	30	0.029		0.026		10.9		6010C
Silver		0.003	U	0.003	U			6010C
Zinc	30	1.275		1.142		11.0		6010C

An empty field in the Control Limit column indicates the control limit is not applicable.

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Simultaneously Extractable Metals

-7-

LABORATORY CONTROL SAMPLE

Client: Golder Associates, Inc. **Service Request:** K1704419

Project No.: 1657231

Project Name: Skagway-Sediment 2017

Aqueous LCS Source: ALS MIXED **Solid LCS Source:**

Analyte	Aqueous (umol/L)			Solid (mg/kg)				
	True	Found	%R	True	Found	C	Limits	%R
Antimony	4.100	3.865	94					
Arsenic	33.400	32.912	99					
Cadmium	11.100	11.009	99					
Chromium	9.610	10.125	105					
Copper	9.830	8.848	90					
Lead	12.100	11.741	97					
Mercury	0.09960	0.10280	103					
Nickel	21.200	21.610	102					
Silver	5.790	5.522	95					
Zinc	19.100	18.883	99					

Diesel and Residual Range Organics

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Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Diesel and Residual Range Organics

Sample Name:	DUP-1	**Units:**	mg/Kg
Lab Code:	K1704419-001	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	43	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	220	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	86	50-150	05/17/17	Acceptable
n-Triacontane	87	50-150	05/17/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/28/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Diesel and Residual Range Organics

Sample Name:	SED17-31	**Units:**	mg/Kg
Lab Code:	K1704419-002	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	42	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	210	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	70	50-150	05/17/17	Acceptable
n-Triacontane	74	50-150	05/17/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Diesel and Residual Range Organics

Sample Name:	SED17-09	**Units:**	mg/Kg
Lab Code:	K1704419-003	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	**79**	Z	35	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	180	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	74	50-150	05/17/17	Acceptable
n-Triacontane	75	50-150	05/17/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Diesel and Residual Range Organics

Sample Name:	SED17-13	**Units:**	mg/Kg
Lab Code:	K1704419-004	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	**44**	Z	37	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	190	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	72	50-150	05/17/17	Acceptable
n-Triacontane	76	50-150	05/17/17	Acceptable

Comments:

Analytical Results

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704419
Date Collected: 04/30/2017
Date Received: 05/04/2017

Diesel and Residual Range Organics

Sample Name: SED17-14
Lab Code: K1704419-005

Units: mg/Kg
Basis: Dry

Extraction Method: EPA 3550B
Analysis Method: AK 102.0/103.0

Level: Low

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	27	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	140	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	87	50-150	05/17/17	Acceptable
n-Triacontane	87	50-150	05/17/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/30/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Diesel and Residual Range Organics

Sample Name:	SED17-11	**Units:**	mg/Kg
Lab Code:	K1704419-006	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	25	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	130	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	71	50-150	05/17/17	Acceptable
n-Triacontane	76	50-150	05/17/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	04/30/2017
Sample Matrix:	Sediment	**Date Received:**	05/04/2017

Diesel and Residual Range Organics

Sample Name:	SED17-17	**Units:**	mg/Kg
Lab Code:	K1704419-007	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	27	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	140	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	74	50-150	05/17/17	Acceptable
n-Triacontane	79	50-150	05/17/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.		**Service Request:**	K1704419
Project:	Skagway-Sediment 2017/1657231		**Date Collected:**	NA
Sample Matrix:	Sediment		**Date Received:**	NA

Diesel and Residual Range Organics

Sample Name:	Method Blank		**Units:**	mg/Kg
Lab Code:	KWG1703859-5		**Basis:**	Dry
Extraction Method:	EPA 3550B		**Level:**	Low
Analysis Method:	AK 102.0/103.0			

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	20	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	98	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	75	50-150	05/17/17	Acceptable
n-Triacontane	78	50-150	05/17/17	Acceptable

Comments:

QA/QC Report

Client: Golder Associates, Inc. **Service Request:** K1704419
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Surrogate Recovery Summary
Diesel and Residual Range Organics

Extraction Method: EPA 3550B **Units:** Percent
Analysis Method: AK 102.0/103.0 **Level:** Low

Sample Name	Lab Code	Sur1	Sur2
DUP-1	K1704419-001	86	87
SED17-31	K1704419-002	70	74
SED17-09	K1704419-003	74	75
SED17-13	K1704419-004	72	76
SED17-14	K1704419-005	87	87
SED17-11	K1704419-006	71	76
SED17-17	K1704419-007	74	79
Method Blank	KWG1703859-5	75	78
SED17-11MS	KWG1703859-1	78	79
SED17-11DMS	KWG1703859-2	79	83
Lab Control Sample	KWG1703859-3	93	95
Duplicate Lab Control Sample	KWG1703859-4	105	100

Surrogate Recovery Control Limits (%)

Sur1	=	o-Terphenyl	50-150
Sur2	=	n-Triacontane	50-150

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

QA/QC Report

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704419
Date Extracted: 05/12/2017
Date Analyzed: 05/17/2017

Matrix Spike/Duplicate Matrix Spike Summary
Diesel and Residual Range Organics

Sample Name: SED17-11
Lab Code: K1704419-006
Extraction Method: EPA 3550B
Analysis Method: AK 102.0/103.0

Units: mg/Kg
Basis: Dry
Level: Low
Extraction Lot: KWG1703859

		SED17-11MS KWG1703859-1 Matrix Spike			SED17-11DMS KWG1703859-2 Duplicate Matrix Spike					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
C10 - C25 DRO	ND	266	327	81	259	328	79	60-140	3	50
C25 - C36 RRO	ND	160	163	98	159	164	97	60-140	0	50

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

QA/QC Report

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704419
Date Extracted: 05/12/2017
Date Analyzed: 05/17/2017 - 05/24/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Diesel and Residual Range Organics

Extraction Method: EPA 3550B
Analysis Method: AK 102.0/103.0

Units: mg/Kg
Basis: Dry
Level: Low
Extraction Lot: KWG1703859

	Lab Control Sample KWG1703859-3 **Lab Control Spike**			Duplicate Lab Control Sample KWG1703859-4 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
C10 - C25 DRO	251	267	94	245	267	92	75-125	2	20
C25 - C36 RRO	140	133	105	154	133	116	60-120	10	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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May 22, 2017

Analytical Report for Service Request No: K1704471

Tamra Reynolds
Golder Associates Ltd.
Suite 201C, 170 Titanium Way
Whitehorse, YT Y1A0G1

RE: Skagway-Sediment 2017 / 1657231

Dear Tamra,

Enclosed are the results of the sample(s) submitted to our laboratory May 05, 2017
For your reference, these analyses have been assigned our service request number **K1704471.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3364. You may also contact me via email at howard.holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Howard Holmes
Project Manager

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Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimated value.
J	The result is an estimated value.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	Not available	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	03016
Maine DHS	Not available	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
North Carolina DWQ	http://www.dwqlab.org/	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/envserv/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS Environmental—Kelso Laboratory
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ALS ENVIRONMENTAL

Client:	Golder Associates, Inc.	**Service Request No.:**	K1704471
Project:	Skagway-Sediment 2017/ 1657231	**Date Received:**	05/05/17
Sample Matrix:	Sediment		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt

Eight sediment samples were received for analysis at ALS Environmental on 05/05/17. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

Total Metals

Matrix Spike Recovery Exceptions:
The control criteria for matrix spike recovery of Aluminum, Calcium, Iron, Magnesium, Potassium, and Sodium for sample SED17-22 were not applicable. The analyte concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

Antimony recoveries are generally low for soil and sediment samples when digested using EPA Method 3050B. Despite anticipated low recoveries, the method is still generally prescribed because of its versatility for general metals analysis. Antimony results (in conjunction with the matrix spike recovery) from this procedure should only be used as indicators to estimate concentrations. The matrix spike recovery of Antimony for sample SED17-22 was below the ALS control criterion. Since low recoveries resulted from a method defect and were possibly magnified by certain matrix components, no corrective action was appropriate. Alternative procedures that specifically target Antimony are available but were not specified for this project. The associated QA/QC results (e.g. control sample, calibration standards, etc.) indicated the analysis was in control.

The matrix spike recovery of Copper for sample SED17-22 was outside the ALS control criteria as a result of the heterogeneous character of the sample. The Relative Percent Difference (RPD) for the replicate analysis supported this. Since the unspiked samples contained high analyte concentrations relative to the amount spiked, the variability between replicates was sufficient to bias the percent recoveries outside normal ALS control criteria. The associated QA/QC results (e.g. control sample, calibration standards, etc.) indicated the analysis was in control. No further corrective action was appropriate.

Approved by ______________________

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for the replicate analysis of Calcium and Copper in sample SED17-22 was outside the normal ALS control limits. The variability in the results was attributed to the heterogeneous character of the sample. Standard mixing techniques were used, but were not sufficient for complete homogenization of this sample.

No other anomalies associated with the analysis of these samples were observed.

Polynuclear Aromatic Hydrocarbons by EPA Method 8270

Surrogate Exceptions:
The control criteria were exceeded for one or more surrogates in the replicate Matrix Spikes (MS/DMS) KWG1703683-1 and KWG1703683-2 of sample Batch QC due to matrix interferences. The presence of non-target background components prevented adequate resolution of the surrogates. Accurate quantitation was not possible. No further corrective action was appropriate.

Matrix Spike Recovery Exceptions:
The Matrix Spike (MS) KWG1703683-1 recovery of Fluoranthene for sample Batch QC was outside control criteria. Recoveries in the replicate Laboratory Control Samples (LCS/DLCS) KWG1703683-3 and KWG1703683-4 were acceptable, which indicated the analytical batch was in control. The matrix spike outlier suggested a potential high bias in this matrix. No further corrective action was appropriate.

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for Fluoranthene in the replicate Matrix Spikes (MS/DMS) KWG1703683-1 and KWG1703683-2 analyses of Batch QC was outside control criteria. The Relative Percent Difference for the analyte in question in the associated replicate Laboratory Control Samples (LCS/DLCS) KWG1703683-3 and KWG1703683-4 was within acceptance limits, indicating the analytical batch was in control. No further corrective action was appropriate.

No other anomalies associated with the analysis of these samples were observed.

Approved by____

Chain of Custody

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K1704471

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 - 593816

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates LTD
Contact:	Tamra Reynolds
Phone:	1-867-334-4468
	Company address below will appear on the final report
Street:	170 - 2011 Titanium Way
City/Province:	Whitehorse, Yukon
Postal Code:	Y1A 0G1
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax TJREYNOLDS@golder.com

Email 2 PADDY_MCMANUS@golder.com

Email 3 VMERCLER@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax same as report

Email 2

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☑ 3 day [P3] ☐ 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: 41037

Job #: 1657231

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Peyfair

Sampler: PW / JM

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals	PAHs	Grainsize (GS)	Total Organic Carbon (TOC)	DRO	AVS/SEM	Number of Containers
	SED17-22	01-MAY-17	13:00	Sediment	X	X	X	X			4
	SED17-21	↓	16:00	↓	↓	↓	↓	↓			↓
	SED17-20	↓	18:00	↓	↓	↓	↓	↓			↓
	SED17-18	02-MAY-17	11:00	↓	↓	↓	↓	↓			↓
	DUP-2	↓	12:00	↓	↓	↓	↓	↓			↓
	SED17-19	↓	13:00	↓	↓	↓	↓	↓			↓
	SED17-24	↓	16:00	↓	↓	↓	↓	↓			↓
	SED17-28	↓	17:00	↓	↓	↓	↓	↓			↓

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Please archive unused samples. 5-day turnaround on metals and PAHs, regular turnaround on GS & TOC, wait for directions for DRO and AVS/SEM.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 4 MAY 17	Time: 6:00	Received by: [signature]	Date: 5/5/17	Time: 0840	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS

PC HH

Cooler Receipt and Preservation Form

Client Golder Assc. Service Request K17 04471

Received: 5/5/17 Opened: 5/5/17 By: [illegible] Unloaded: 5/5/17 By: [illegible]

1. Samples were received via? *USPS* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* ______ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where? one, front

   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
0.8	0.7	—	—	-0.1	373		027 JNU 3174 5033	

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* box
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA Y N

   If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

RUSH

Notes, Discrepancies, & Resolutions:

7/25/16

Page ____ ***of*** ____

Total Solids

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ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/17 - 05/02/17
Sample Matrix:	Sediment	**Date Received:**	05/5/17
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
SED17-22	K1704471-001	**63.7**	-	1	05/05/17 17:28	
SED17-21	K1704471-002	**62.7**	-	1	05/05/17 17:28	
SED17-20	K1704471-003	**53.8**	-	1	05/05/17 17:28	
SED17-18	K1704471-004	**65.7**	-	1	05/05/17 17:28	
DUP-2	K1704471-005	**63.2**	-	1	05/05/17 17:28	
SED17-19	K1704471-006	**60.6**	-	1	05/05/17 17:28	
SED17-24	K1704471-007	**75.8**	-	1	05/05/17 17:28	
SED17-28	K1704471-008	**68.1**	-	1	05/05/17 17:28	

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Batch QC	K1704419-003DUP	-	57.3	57.2	57.3	<1	20	05/05/17
Batch QC	K1704473-006DUP	-	59.5	59.5	59.5	<1	20	05/05/17
Batch QC	K1704476-002DUP	-	81.4	85.3	83.4	5	20	05/05/17

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Metals

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/17 13:00
Sample Matrix:	Sediment	**Date Received:**	05/05/17 08:40
Sample Name:	SED17-22	**Basis:**	Dry
Lab Code:	K1704471-001		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**14700**	mg/Kg	2.6	2	05/09/17 13:20	05/05/17	
Antimony	6020A	**0.096**	mg/Kg	0.066	5	05/11/17 08:10	05/05/17	
Arsenic	6020A	**4.34**	mg/Kg	0.66	5	05/11/17 08:10	05/05/17	
Barium	6010C	**337**	mg/Kg	1.1	2	05/09/17 13:20	05/05/17	
Beryllium	6020A	**0.279**	mg/Kg	0.026	5	05/11/17 08:10	05/05/17	
Cadmium	6020A	**0.541**	mg/Kg	0.026	5	05/11/17 08:10	05/05/17	
Calcium	6010C	**30500**	mg/Kg	5.3	2	05/09/17 13:20	05/05/17	
Chromium	6020A	**16.9**	mg/Kg	0.26	5	05/11/17 08:10	05/05/17	
Cobalt	6020A	**7.70**	mg/Kg	0.026	5	05/11/17 08:10	05/05/17	
Copper	6020A	**82.5**	mg/Kg	0.13	5	05/11/17 08:10	05/05/17	
Iron	6010C	**30400**	mg/Kg	5.3	2	05/09/17 13:20	05/05/17	
Lead	6020A	**41.6**	mg/Kg	0.066	5	05/11/17 08:10	05/05/17	
Magnesium	6010C	**9380**	mg/Kg	2.6	2	05/09/17 13:20	05/05/17	
Manganese	6010C	**398**	mg/Kg	0.26	2	05/09/17 13:20	05/05/17	
Mercury	7471B	**0.034**	mg/Kg	0.021	1	05/09/17 12:48	05/08/17	
Nickel	6020A	**9.56**	mg/Kg	0.26	5	05/11/17 08:10	05/05/17	
Potassium	6010C	**6890**	mg/Kg	53	2	05/09/17 13:20	05/05/17	
Selenium	6020A	ND U	mg/Kg	1.3	5	05/11/17 08:10	05/05/17	
Silver	6020A	**0.506**	mg/Kg	0.026	5	05/11/17 08:10	05/05/17	
Sodium	6010C	**7810**	mg/Kg	53	2	05/09/17 13:20	05/05/17	
Thallium	6020A	**0.326**	mg/Kg	0.026	5	05/11/17 08:10	05/05/17	
Vanadium	6020A	**52.5**	mg/Kg	0.26	5	05/11/17 08:10	05/05/17	
Zinc	6010C	**196**	mg/Kg	1.3	2	05/09/17 13:20	05/05/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/17 16:00
Sample Matrix:	Sediment	**Date Received:**	05/05/17 08:40
Sample Name:	SED17-21	**Basis:**	Dry
Lab Code:	K1704471-002		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**14800**		mg/Kg	3.1	2	05/09/17 13:30	05/05/17	
Antimony	6020A	**0.142**		mg/Kg	0.078	5	05/11/17 08:49	05/05/17	
Arsenic	6020A	**6.11**		mg/Kg	0.78	5	05/11/17 08:49	05/05/17	
Barium	6010C	**339**		mg/Kg	1.3	2	05/09/17 13:30	05/05/17	
Beryllium	6020A	**0.372**		mg/Kg	0.031	5	05/11/17 08:49	05/05/17	
Cadmium	6020A	**0.623**		mg/Kg	0.031	5	05/11/17 08:49	05/05/17	
Calcium	6010C	**63300**		mg/Kg	6.3	2	05/09/17 13:30	05/05/17	
Chromium	6020A	**24.6**		mg/Kg	0.31	5	05/11/17 08:49	05/05/17	
Cobalt	6020A	**9.53**		mg/Kg	0.031	5	05/11/17 08:49	05/05/17	
Copper	6020A	**45.6**		mg/Kg	0.16	5	05/11/17 08:49	05/05/17	
Iron	6010C	**31000**		mg/Kg	6.3	2	05/09/17 13:30	05/05/17	
Lead	6020A	**29.9**		mg/Kg	0.078	5	05/11/17 08:49	05/05/17	
Magnesium	6010C	**9730**		mg/Kg	3.1	2	05/09/17 13:30	05/05/17	
Manganese	6010C	**403**		mg/Kg	0.31	2	05/09/17 13:30	05/05/17	
Mercury	7471B	ND	U	mg/Kg	0.025	1	05/09/17 12:49	05/08/17	
Nickel	6020A	**13.5**		mg/Kg	0.31	5	05/11/17 08:49	05/05/17	
Potassium	6010C	**7010**		mg/Kg	63	2	05/09/17 13:30	05/05/17	
Selenium	6020A	ND	U	mg/Kg	1.6	5	05/11/17 08:49	05/05/17	
Silver	6020A	**0.281**		mg/Kg	0.031	5	05/11/17 08:49	05/05/17	
Sodium	6010C	**8680**		mg/Kg	63	2	05/09/17 13:30	05/05/17	
Thallium	6020A	**0.419**		mg/Kg	0.031	5	05/11/17 08:49	05/05/17	
Vanadium	6020A	**61.4**		mg/Kg	0.31	5	05/11/17 08:49	05/05/17	
Zinc	6010C	**198**		mg/Kg	1.6	2	05/09/17 13:30	05/05/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/17 18:00
Sample Matrix:	Sediment	**Date Received:**	05/05/17 08:40
Sample Name:	SED17-20	**Basis:**	Dry
Lab Code:	K1704471-003		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**17800**	mg/Kg	2.8	2	05/09/17 13:32	05/05/17	
Antimony	6020A	**0.295**	mg/Kg	0.070	5	05/11/17 08:53	05/05/17	
Arsenic	6020A	**4.58**	mg/Kg	0.70	5	05/11/17 08:53	05/05/17	
Barium	6010C	**421**	mg/Kg	1.1	2	05/09/17 13:32	05/05/17	
Beryllium	6020A	**0.359**	mg/Kg	0.028	5	05/11/17 08:53	05/05/17	
Cadmium	6020A	**0.794**	mg/Kg	0.028	5	05/11/17 08:53	05/05/17	
Calcium	6010C	**22300**	mg/Kg	5.6	2	05/09/17 13:32	05/05/17	
Chromium	6020A	**23.1**	mg/Kg	0.28	5	05/11/17 08:53	05/05/17	
Cobalt	6020A	**10.4**	mg/Kg	0.028	5	05/11/17 08:53	05/05/17	
Copper	6020A	**26.5**	mg/Kg	0.14	5	05/11/17 08:53	05/05/17	
Iron	6010C	**34800**	mg/Kg	5.6	2	05/09/17 13:32	05/05/17	
Lead	6020A	**33.9**	mg/Kg	0.070	5	05/11/17 08:53	05/05/17	
Magnesium	6010C	**11500**	mg/Kg	2.8	2	05/09/17 13:32	05/05/17	
Manganese	6010C	**475**	mg/Kg	0.28	2	05/09/17 13:32	05/05/17	
Mercury	7471B	ND U	mg/Kg	0.024	1	05/09/17 12:51	05/08/17	
Nickel	6020A	**13.2**	mg/Kg	0.28	5	05/11/17 08:53	05/05/17	
Potassium	6010C	**8630**	mg/Kg	56	2	05/09/17 13:32	05/05/17	
Selenium	6020A	ND U	mg/Kg	1.4	5	05/11/17 08:53	05/05/17	
Silver	6020A	**1.63**	mg/Kg	0.028	5	05/11/17 08:53	05/05/17	
Sodium	6010C	**11000**	mg/Kg	56	2	05/09/17 13:32	05/05/17	
Thallium	6020A	**0.430**	mg/Kg	0.028	5	05/11/17 08:53	05/05/17	
Vanadium	6020A	**70.4**	mg/Kg	0.28	5	05/11/17 08:53	05/05/17	
Zinc	6010C	**173**	mg/Kg	1.4	2	05/09/17 13:32	05/05/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/02/17 11:00
Sample Matrix:	Sediment	**Date Received:**	05/05/17 08:40
Sample Name:	SED17-18	**Basis:**	Dry
Lab Code:	K1704471-004		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**13300**	mg/Kg	2.4	2	05/09/17 13:34	05/05/17	
Antimony	6020A	**0.066**	mg/Kg	0.061	5	05/11/17 08:57	05/05/17	
Arsenic	6020A	**3.37**	mg/Kg	0.61	5	05/11/17 08:57	05/05/17	
Barium	6010C	**295**	mg/Kg	0.98	2	05/09/17 13:34	05/05/17	
Beryllium	6020A	**0.276**	mg/Kg	0.024	5	05/11/17 08:57	05/05/17	
Cadmium	6020A	**0.613**	mg/Kg	0.024	5	05/11/17 08:57	05/05/17	
Calcium	6010C	**9640**	mg/Kg	4.9	2	05/09/17 13:34	05/05/17	
Chromium	6020A	**16.9**	mg/Kg	0.24	5	05/11/17 08:57	05/05/17	
Cobalt	6020A	**8.00**	mg/Kg	0.024	5	05/11/17 08:57	05/05/17	
Copper	6020A	**46.0**	mg/Kg	0.12	5	05/11/17 08:57	05/05/17	
Iron	6010C	**24700**	mg/Kg	4.9	2	05/09/17 13:34	05/05/17	
Lead	6020A	**119**	mg/Kg	0.061	5	05/11/17 08:57	05/05/17	
Magnesium	6010C	**8390**	mg/Kg	2.4	2	05/09/17 13:34	05/05/17	
Manganese	6010C	**329**	mg/Kg	0.24	2	05/09/17 13:34	05/05/17	
Mercury	7471B	**0.152**	mg/Kg	0.024	1	05/09/17 12:56	05/08/17	
Nickel	6020A	**8.82**	mg/Kg	0.24	5	05/11/17 08:57	05/05/17	
Potassium	6010C	**6220**	mg/Kg	49	2	05/09/17 13:34	05/05/17	
Selenium	6020A	ND U	mg/Kg	1.2	5	05/11/17 08:57	05/05/17	
Silver	6020A	**0.330**	mg/Kg	0.024	5	05/11/17 08:57	05/05/17	
Sodium	6010C	**7010**	mg/Kg	49	2	05/09/17 13:34	05/05/17	
Thallium	6020A	**0.303**	mg/Kg	0.024	5	05/11/17 08:57	05/05/17	
Vanadium	6020A	**55.7**	mg/Kg	0.24	5	05/11/17 08:57	05/05/17	
Zinc	6010C	**240**	mg/Kg	1.2	2	05/09/17 13:34	05/05/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/02/17 12:00
Sample Matrix:	Sediment	**Date Received:**	05/05/17 08:40
Sample Name:	DUP-2	**Basis:**	Dry
Lab Code:	K1704471-005		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**13400**	mg/Kg	1.8	2	05/09/17 13:37	05/05/17	
Antimony	6020A	**0.079**	mg/Kg	0.046	5	05/11/17 09:00	05/05/17	
Arsenic	6020A	**3.26**	mg/Kg	0.46	5	05/11/17 09:00	05/05/17	
Barium	6010C	**299**	mg/Kg	0.73	2	05/09/17 13:37	05/05/17	
Beryllium	6020A	**0.244**	mg/Kg	0.018	5	05/11/17 09:00	05/05/17	
Cadmium	6020A	**0.603**	mg/Kg	0.018	5	05/11/17 09:00	05/05/17	
Calcium	6010C	**15400**	mg/Kg	3.7	2	05/09/17 13:37	05/05/17	
Chromium	6020A	**15.6**	mg/Kg	0.18	5	05/11/17 09:00	05/05/17	
Cobalt	6020A	**7.25**	mg/Kg	0.018	5	05/11/17 09:00	05/05/17	
Copper	6020A	**38.1**	mg/Kg	0.092	5	05/11/17 09:00	05/05/17	
Iron	6010C	**24600**	mg/Kg	3.7	2	05/09/17 13:37	05/05/17	
Lead	6020A	**112**	mg/Kg	0.046	5	05/11/17 09:00	05/05/17	
Magnesium	6010C	**8480**	mg/Kg	1.8	2	05/09/17 13:37	05/05/17	
Manganese	6010C	**327**	mg/Kg	0.18	2	05/09/17 13:37	05/05/17	
Mercury	7471B	**0.171**	mg/Kg	0.028	1	05/09/17 12:57	05/08/17	
Nickel	6020A	**8.20**	mg/Kg	0.18	5	05/11/17 09:00	05/05/17	
Potassium	6010C	**6240**	mg/Kg	37	2	05/09/17 13:37	05/05/17	
Selenium	6020A	ND U	mg/Kg	0.92	5	05/11/17 09:00	05/05/17	
Silver	6020A	**0.327**	mg/Kg	0.018	5	05/11/17 09:00	05/05/17	
Sodium	6010C	**7260**	mg/Kg	37	2	05/09/17 13:37	05/05/17	
Thallium	6020A	**0.291**	mg/Kg	0.018	5	05/11/17 09:00	05/05/17	
Vanadium	6020A	**51.6**	mg/Kg	0.18	5	05/11/17 09:00	05/05/17	
Zinc	6010C	**240**	mg/Kg	0.92	2	05/09/17 13:37	05/05/17	

Printed 05/11/17 5:05:49 PM Superset Reference:

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/02/17 13:00
Sample Matrix:	Sediment	**Date Received:**	05/05/17 08:40
Sample Name:	SED17-19	**Basis:**	Dry
Lab Code:	K1704471-006		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**12600**		mg/Kg	2.5	2	05/09/17 13:49	05/05/17	
Antimony	6020A	ND	U	mg/Kg	0.063	5	05/11/17 09:04	05/05/17	
Arsenic	6020A	**3.02**		mg/Kg	0.63	5	05/11/17 09:04	05/05/17	
Barium	6010C	**305**		mg/Kg	1.0	2	05/09/17 13:49	05/05/17	
Beryllium	6020A	**0.248**		mg/Kg	0.025	5	05/11/17 09:04	05/05/17	
Cadmium	6020A	**0.436**		mg/Kg	0.025	5	05/11/17 09:04	05/05/17	
Calcium	6010C	**147000**		mg/Kg	25	10	05/09/17 13:57	05/05/17	
Chromium	6020A	**16.7**		mg/Kg	0.25	5	05/11/17 09:04	05/05/17	
Cobalt	6020A	**7.10**		mg/Kg	0.025	5	05/11/17 09:04	05/05/17	
Copper	6020A	**28.2**		mg/Kg	0.13	5	05/11/17 09:04	05/05/17	
Iron	6010C	**25200**		mg/Kg	5.0	2	05/09/17 13:49	05/05/17	
Lead	6020A	**77.1**		mg/Kg	0.063	5	05/11/17 09:04	05/05/17	
Magnesium	6010C	**8690**		mg/Kg	2.5	2	05/09/17 13:49	05/05/17	
Manganese	6010C	**334**		mg/Kg	0.25	2	05/09/17 13:49	05/05/17	
Mercury	7471B	**0.129**		mg/Kg	0.027	1	05/09/17 12:59	05/08/17	
Nickel	6020A	**9.17**		mg/Kg	0.25	5	05/11/17 09:04	05/05/17	
Potassium	6010C	**6440**		mg/Kg	50	2	05/09/17 13:49	05/05/17	
Selenium	6020A	ND	U	mg/Kg	1.3	5	05/11/17 09:04	05/05/17	
Silver	6020A	**0.227**		mg/Kg	0.025	5	05/11/17 09:04	05/05/17	
Sodium	6010C	**8260**		mg/Kg	50	2	05/09/17 13:49	05/05/17	
Thallium	6020A	**0.279**		mg/Kg	0.025	5	05/11/17 09:04	05/05/17	
Vanadium	6020A	**50.2**		mg/Kg	0.25	5	05/11/17 09:04	05/05/17	
Zinc	6010C	**174**		mg/Kg	1.3	2	05/09/17 13:49	05/05/17	

Client:	Golder Associates, Inc.		**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231		**Date Collected:**	05/02/17 16:00
Sample Matrix:	Sediment		**Date Received:**	05/05/17 08:40
Sample Name:	SED17-24		**Basis:**	Dry
Lab Code:	K1704471-007			

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**10600**		mg/Kg	2.5	2	05/09/17 13:52	05/05/17	
Antimony	6020A	ND	U	mg/Kg	0.063	5	05/11/17 09:07	05/05/17	
Arsenic	6020A	**2.77**		mg/Kg	0.63	5	05/11/17 09:07	05/05/17	
Barium	6010C	**222**		mg/Kg	1.0	2	05/09/17 13:52	05/05/17	
Beryllium	6020A	**0.201**		mg/Kg	0.025	5	05/11/17 09:07	05/05/17	
Cadmium	6020A	**0.112**		mg/Kg	0.025	5	05/11/17 09:07	05/05/17	
Calcium	6010C	**16100**		mg/Kg	5.0	2	05/09/17 13:52	05/05/17	
Chromium	6020A	**14.0**		mg/Kg	0.25	5	05/11/17 09:07	05/05/17	
Cobalt	6020A	**6.96**		mg/Kg	0.025	5	05/11/17 09:07	05/05/17	
Copper	6020A	**8.68**		mg/Kg	0.13	5	05/11/17 09:07	05/05/17	
Iron	6010C	**18700**		mg/Kg	5.0	2	05/09/17 13:52	05/05/17	
Lead	6020A	**8.13**		mg/Kg	0.063	5	05/11/17 09:07	05/05/17	
Magnesium	6010C	**6090**		mg/Kg	2.5	2	05/09/17 13:52	05/05/17	
Manganese	6010C	**282**		mg/Kg	0.25	2	05/09/17 13:52	05/05/17	
Mercury	7471B	ND	U	mg/Kg	0.015	1	05/09/17 13:01	05/08/17	
Nickel	6020A	**6.97**		mg/Kg	0.25	5	05/11/17 09:07	05/05/17	
Potassium	6010C	**4230**		mg/Kg	50	2	05/09/17 13:52	05/05/17	
Selenium	6020A	ND	U	mg/Kg	1.3	5	05/11/17 09:07	05/05/17	
Silver	6020A	**0.077**		mg/Kg	0.025	5	05/11/17 09:07	05/05/17	
Sodium	6010C	**4490**		mg/Kg	50	2	05/09/17 13:52	05/05/17	
Thallium	6020A	**0.216**		mg/Kg	0.025	5	05/11/17 09:07	05/05/17	
Vanadium	6020A	**41.6**		mg/Kg	0.25	5	05/11/17 09:07	05/05/17	
Zinc	6010C	**52.6**		mg/Kg	1.3	2	05/09/17 13:52	05/05/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/02/17 17:00
Sample Matrix:	Sediment	**Date Received:**	05/05/17 08:40
Sample Name:	SED17-28	**Basis:**	Dry
Lab Code:	K1704471-008		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**16200**		mg/Kg	2.5	2	05/09/17 13:54	05/05/17	
Antimony	6020A	ND	U	mg/Kg	0.064	5	05/11/17 09:11	05/05/17	
Arsenic	6020A	**2.61**		mg/Kg	0.64	5	05/11/17 09:11	05/05/17	
Barium	6010C	**285**		mg/Kg	1.0	2	05/09/17 13:54	05/05/17	
Beryllium	6020A	**0.170**		mg/Kg	0.025	5	05/11/17 09:11	05/05/17	
Cadmium	6020A	**0.160**		mg/Kg	0.025	5	05/11/17 09:11	05/05/17	
Calcium	6010C	**8680**		mg/Kg	5.1	2	05/09/17 13:54	05/05/17	
Chromium	6020A	**16.9**		mg/Kg	0.25	5	05/11/17 09:11	05/05/17	
Cobalt	6020A	**6.66**		mg/Kg	0.025	5	05/11/17 09:11	05/05/17	
Copper	6020A	**8.15**		mg/Kg	0.13	5	05/11/17 09:11	05/05/17	
Iron	6010C	**21900**		mg/Kg	5.1	2	05/09/17 13:54	05/05/17	
Lead	6020A	**5.06**		mg/Kg	0.064	5	05/11/17 09:11	05/05/17	
Magnesium	6010C	**7600**		mg/Kg	2.5	2	05/09/17 13:54	05/05/17	
Manganese	6010C	**270**		mg/Kg	0.25	2	05/09/17 13:54	05/05/17	
Mercury	7471B	ND	U	mg/Kg	0.026	1	05/09/17 13:02	05/08/17	
Nickel	6020A	**8.42**		mg/Kg	0.25	5	05/11/17 09:11	05/05/17	
Potassium	6010C	**4820**		mg/Kg	51	2	05/09/17 13:54	05/05/17	
Selenium	6020A	ND	U	mg/Kg	1.3	5	05/11/17 09:11	05/05/17	
Silver	6020A	**0.085**		mg/Kg	0.025	5	05/11/17 09:11	05/05/17	
Sodium	6010C	**6610**		mg/Kg	51	2	05/09/17 13:54	05/05/17	
Thallium	6020A	**0.249**		mg/Kg	0.025	5	05/11/17 09:11	05/05/17	
Vanadium	6020A	**39.6**		mg/Kg	0.25	5	05/11/17 09:11	05/05/17	
Zinc	6010C	**61.9**		mg/Kg	1.3	2	05/09/17 13:54	05/05/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ1705558-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	ND U	mg/Kg	2	2	05/09/17 13:15	05/05/17	
Antimony	6020A	ND U	mg/Kg	0.05	5	05/11/17 08:03	05/05/17	
Arsenic	6020A	ND U	mg/Kg	0.5	5	05/11/17 08:03	05/05/17	
Barium	6010C	ND U	mg/Kg	0.8	2	05/09/17 13:15	05/05/17	
Beryllium	6020A	ND U	mg/Kg	0.020	5	05/11/17 08:03	05/05/17	
Cadmium	6020A	ND U	mg/Kg	0.020	5	05/11/17 08:03	05/05/17	
Calcium	6010C	ND U	mg/Kg	4	2	05/09/17 13:15	05/05/17	
Chromium	6020A	ND U	mg/Kg	0.20	5	05/11/17 08:03	05/05/17	
Cobalt	6020A	ND U	mg/Kg	0.020	5	05/11/17 08:03	05/05/17	
Copper	6020A	ND U	mg/Kg	0.10	5	05/11/17 08:03	05/05/17	
Iron	6010C	ND U	mg/Kg	4	2	05/09/17 13:15	05/05/17	
Lead	6020A	ND U	mg/Kg	0.05	5	05/11/17 08:03	05/05/17	
Magnesium	6010C	ND U	mg/Kg	2	2	05/09/17 13:15	05/05/17	
Manganese	6010C	ND U	mg/Kg	0.2	2	05/09/17 13:15	05/05/17	
Nickel	6020A	ND U	mg/Kg	0.20	5	05/11/17 08:03	05/05/17	
Potassium	6010C	ND U	mg/Kg	40	2	05/09/17 13:15	05/05/17	
Selenium	6020A	ND U	mg/Kg	1.0	5	05/11/17 08:03	05/05/17	
Silver	6020A	ND U	mg/Kg	0.020	5	05/11/17 08:03	05/05/17	
Sodium	6010C	ND U	mg/Kg	40	2	05/09/17 13:15	05/05/17	
Thallium	6020A	ND U	mg/Kg	0.020	5	05/11/17 08:03	05/05/17	
Vanadium	6020A	ND U	mg/Kg	0.20	5	05/11/17 08:03	05/05/17	
Zinc	6010C	ND U	mg/Kg	1.0	2	05/09/17 13:15	05/05/17	

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ1705542-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Mercury	7471B	ND U	mg/Kg	0.02	1	05/09/17 12:25	05/08/17	

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/17
Sample Matrix:	Sediment	**Date Received:**	05/05/17
		Date Analyzed:	05/09/17 - 05/11/17

Replicate Sample Summary
Total Metals

Sample Name:	SED17-22	**Units:**	mg/Kg
Lab Code:	K1704471-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1705558-03 Result	Average	RPD	RPD Limit
Aluminum	6010C	2.9	14700	14500	14600	2	20
Antimony	6020A	0.072	0.096	0.101	0.099	5	20
Arsenic	6020A	0.72	4.34	4.31	4.33	<1	20
Barium	6010C	1.2	337	340	339	<1	20
Beryllium	6020A	0.029	0.279	0.282	0.281	1	20
Cadmium	6020A	0.029	0.541	0.646	0.594	18	20
Calcium	6010C	5.8	30500	38400	34500	23 *	20
Chromium	6020A	0.29	16.9	17.7	17.3	5	20
Cobalt	6020A	0.029	7.70	7.69	7.70	<1	20
Copper	6020A	0.14	82.5	41.3	61.9	67 *	20
Iron	6010C	5.8	30400	29500	30000	3	20
Lead	6020A	0.072	41.6	44.7	43.2	7	20
Magnesium	6010C	2.9	9380	9410	9400	<1	20
Manganese	6010C	0.29	398	389	394	2	20
Nickel	6020A	0.29	9.56	9.68	9.62	1	20
Potassium	6010C	58	6890	6940	6920	<1	20
Selenium	6020A	1.4	ND U	ND U	ND	-	20
Silver	6020A	0.029	0.506	0.541	0.524	7	20
Sodium	6010C	58	7810	8080	7950	3	20
Thallium	6020A	0.029	0.326	0.318	0.322	3	20
Vanadium	6020A	0.29	52.5	53.1	52.8	1	20
Zinc	6010C	1.4	196	208	202	6	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
		Date Analyzed:	05/09/17

Replicate Sample Summary
Total Metals

Sample Name:	Batch QC	**Units:**	mg/Kg
Lab Code:	K1704415-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1705542-03 Result	Average	RPD	RPD Limit
Mercury	7471B	0.021	ND U	ND U	ND	-	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704471
Date Collected: 05/01/17
Date Received: 05/05/17
Date Analyzed: 05/09/17 - 05/11/17

Matrix Spike Summary
Total Metals

Sample Name: SED17-22
Lab Code: K1704471-001

Units: mg/Kg
Basis: Dry

Matrix Spike
KQ1705558-04

Analyte Name	Method	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6010C	14700	15100	600	69 #	75-125
Antimony	6020A	0.096	36.0	150	24 N	75-125
Arsenic	6020A	4.34	154	150	100	75-125
Barium	6010C	337	647	300	104	75-125
Beryllium	6020A	0.279	15.0	15.0	99	75-125
Cadmium	6020A	0.541	16.5	15.0	107	75-125
Calcium	6010C	30500	33000	1500	167 #	75-125
Chromium	6020A	16.9	79.1	60.0	104	75-125
Cobalt	6020A	7.70	159	150	101	75-125
Copper	6020A	82.5	182	74.9	133 N	75-125
Iron	6010C	30400	30200	300	-83 #	75-125
Lead	6020A	41.6	198	150	104	75-125
Magnesium	6010C	9380	10700	1500	85 #	75-125
Manganese	6010C	398	538	150	94	75-125
Nickel	6020A	9.56	159	150	100	75-125
Potassium	6010C	6890	8270	1500	92 #	75-125
Selenium	6020A	ND U	152	150	102	75-125
Silver	6020A	0.506	15.9	15.0	103	75-125
Sodium	6010C	7810	9310	1500	100 #	75-125
Thallium	6020A	0.326	30.6	30.0	101	75-125
Vanadium	6020A	52.5	210	150	105	75-125
Zinc	6010C	196	358	150	108	75-125

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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Superset Reference:

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	N/A
Sample Matrix:	Sediment	**Date Received:**	N/A
		Date Analyzed:	05/9/17
		Date Extracted:	05/8/17

Matrix Spike Summary
Total Metals

Sample Name:	Batch QC	**Units:**	mg/Kg
Lab Code:	K1704415-001	**Basis:**	Dry
Analysis Method:	7471B		
Prep Method:	Method		

Matrix Spike
KQ1705542-04

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Mercury	ND U	0.590	0.549	108	80-120

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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QA/QC Report

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704471
Date Analyzed: 05/09/17

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1705558-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6010C	6880	7930	87	39-161
Barium	6010C	322	308	104	74-126
Calcium	6010C	6730	6610	102	74-126
Iron	6010C	11700	14400	81	36-164
Magnesium	6010C	2550	2640	96	64-136
Manganese	6010C	425	410	104	76-124
Potassium	6010C	2470	2550	97	61-139
Sodium	6010C	3180	2480	128	65-173
Zinc	6010C	190	191	100	70-130

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Superset Reference:

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704471
Date Analyzed: 05/11/17

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1705558-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Antimony	6020A	51.2	105	49	20-254
Arsenic	6020A	102	98.5	103	69-145
Beryllium	6020A	66.2	66.0	100	74-126
Cadmium	6020A	169	146	116	73-127
Chromium	6020A	188	182	103	71-130
Cobalt	6020A	181	162	112	74-125
Copper	6020A	108	106	102	75-125
Lead	6020A	130	130	100	72-127
Nickel	6020A	166	149	112	73-127
Selenium	6020A	169	154	110	68-132
Silver	6020A	42.6	40.9	104	66-134
Thallium	6020A	210	175	120	69-131
Vanadium	6020A	99.6	96.7	103	65-135

Client: Golder Associates, Inc. **Service Request:** K1704471
Project: Skagway-Sediment 2017/1657231 **Date Analyzed:** 05/09/17
Sample Matrix: Sediment

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1705542-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Mercury	7471B	0.498	0.500	100	51-148

Polynuclear Aromatic Hydrocarbons

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/2017
Sample Matrix:	Sediment	**Date Received:**	05/05/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-22	**Units:**	ug/Kg
Lab Code:	K1704471-001	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	7.6	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	7.6	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	ND	U	7.6	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	7.6	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	ND	U	7.6	1	05/08/17	05/10/17	KWG1703683	
Fluorene	ND	U	7.6	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**17**		7.6	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**11**		7.6	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**43**		7.6	1	05/08/17	05/10/17	KWG1703683	
Pyrene	**63**		7.6	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**45**		7.6	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**67**		7.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**80**		7.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**37**		7.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**37**		7.6	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	**18**		7.6	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	ND	U	7.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	**16**		7.6	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	70	38-104	05/10/17	Acceptable
Fluoranthene-d10	87	39-109	05/10/17	Acceptable
Terphenyl-d14	88	38-113	05/10/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/2017
Sample Matrix:	Sediment	**Date Received:**	05/05/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-21	**Units:**	ug/Kg
Lab Code:	K1704471-002	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	7.7	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	7.7	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	ND	U	7.7	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	7.7	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	**9.8**		7.7	1	05/08/17	05/10/17	KWG1703683	
Fluorene	**9.9**		7.7	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**25**		7.7	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**14**		7.7	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**38**		7.7	1	05/08/17	05/10/17	KWG1703683	
Pyrene	**39**		7.7	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**22**		7.7	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**40**		7.7	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**24**		7.7	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**13**		7.7	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**9.8**		7.7	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	**8.3**		7.7	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	ND	U	7.7	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	ND	U	7.7	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	75	38-104	05/10/17	Acceptable
Fluoranthene-d10	95	39-109	05/10/17	Acceptable
Terphenyl-d14	93	38-113	05/10/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/2017
Sample Matrix:	Sediment	**Date Received:**	05/05/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-20	**Units:**	ug/Kg
Lab Code:	K1704471-003	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**100**		9.1	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	**62**		9.1	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	ND	U	9.1	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	**26**		9.1	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	**35**		9.1	1	05/08/17	05/10/17	KWG1703683	
Fluorene	**26**		9.1	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**66**		9.1	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**32**		9.1	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**350**		9.1	1	05/08/17	05/10/17	KWG1703683	
Pyrene	**240**		9.1	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**86**		9.1	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**72**		9.1	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**110**		9.1	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**42**		9.1	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**45**		9.1	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	**23**		9.1	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	ND	U	9.1	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	**19**		9.1	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	76	38-104	05/10/17	Acceptable
Fluoranthene-d10	98	39-109	05/10/17	Acceptable
Terphenyl-d14	94	38-113	05/10/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/02/2017
Sample Matrix:	Sediment	**Date Received:**	05/05/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-18	**Units:**	ug/Kg
Lab Code:	K1704471-004	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	7.6	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	7.6	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	**7.9**		7.6	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	**15**		7.6	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	**13**		7.6	1	05/08/17	05/10/17	KWG1703683	
Fluorene	**29**		7.6	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**190**		7.6	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**70**		7.6	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**800**		7.6	1	05/08/17	05/10/17	KWG1703683	
Pyrene	**560**		7.6	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**260**		7.6	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**290**		7.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**330**		7.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**120**		7.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**140**		7.6	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	**62**		7.6	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	**16**		7.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	**49**		7.6	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	81	38-104	05/10/17	Acceptable
Fluoranthene-d10	105	39-109	05/10/17	Acceptable
Terphenyl-d14	102	38-113	05/10/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/02/2017
Sample Matrix:	Sediment	**Date Received:**	05/05/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	DUP-2	**Units:**	ug/Kg
Lab Code:	K1704471-005	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	7.8	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	**8.9**		7.8	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	**11**		7.8	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	**17**		7.8	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	**22**		7.8	1	05/08/17	05/10/17	KWG1703683	
Fluorene	**52**		7.8	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**380**		7.8	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**76**		7.8	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**1000**		7.8	1	05/08/17	05/10/17	KWG1703683	
Pyrene	**690**		7.8	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**390**		7.8	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**400**		7.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**400**		7.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**160**		7.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**170**		7.8	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	**77**		7.8	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	**23**		7.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	**59**		7.8	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	82	38-104	05/10/17	Acceptable
Fluoranthene-d10	103	39-109	05/10/17	Acceptable
Terphenyl-d14	101	38-113	05/10/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/02/2017
Sample Matrix:	Sediment	**Date Received:**	05/05/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-19	**Units:**	ug/Kg
Lab Code:	K1704471-006	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	8.2	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	8.2	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	**13**		8.2	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	8.2	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	**13**		8.2	1	05/08/17	05/10/17	KWG1703683	
Fluorene	**28**		8.2	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	**150**		8.2	1	05/08/17	05/10/17	KWG1703683	
Anthracene	**150**		8.2	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	**710**		8.2	1	05/08/17	05/10/17	KWG1703683	
Pyrene	**460**		8.2	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	**450**		8.2	1	05/08/17	05/10/17	KWG1703683	
Chrysene	**480**		8.2	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	**420**		8.2	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	**180**		8.2	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	**210**		8.2	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	**95**		8.2	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	**24**		8.2	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	**73**		8.2	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	82	38-104	05/10/17	Acceptable
Fluoranthene-d10	106	39-109	05/10/17	Acceptable
Terphenyl-d14	105	38-113	05/10/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704471
Date Collected: 05/02/2017
Date Received: 05/05/2017

Polynuclear Aromatic Hydrocarbons

Sample Name: SED17-24
Lab Code: K1704471-007
Extraction Method: EPA 3546
Analysis Method: 8270D SIM

Units: ug/Kg
Basis: Dry
Level: Low

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Fluorene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Anthracene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Pyrene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Chrysene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	ND	U	6.6	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	77	38-104	05/10/17	Acceptable
Fluoranthene-d10	85	39-109	05/10/17	Acceptable
Terphenyl-d14	92	38-113	05/10/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/02/2017
Sample Matrix:	Sediment	**Date Received:**	05/05/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-28	**Units:**	ug/Kg
Lab Code:	K1704471-008	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Fluorene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Anthracene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Pyrene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Chrysene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	ND	U	7.3	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	77	38-104	05/10/17	Acceptable
Fluoranthene-d10	85	39-109	05/10/17	Acceptable
Terphenyl-d14	90	38-113	05/10/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Polynuclear Aromatic Hydrocarbons

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG1703683-5	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
2-Methylnaphthalene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Acenaphthylene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Acenaphthene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Dibenzofuran	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Fluorene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Phenanthrene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Anthracene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Fluoranthene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Pyrene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Benz(a)anthracene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Chrysene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(b)fluoranthene†	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(k)fluoranthene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(a)pyrene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Indeno(1,2,3-cd)pyrene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Dibenz(a,h)anthracene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	
Benzo(g,h,i)perylene	ND	U	4.8	1	05/08/17	05/10/17	KWG1703683	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	72	38-104	05/10/17	Acceptable
Fluoranthene-d10	77	39-109	05/10/17	Acceptable
Terphenyl-d14	87	38-113	05/10/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

QA/QC Report

Client: Golder Associates, Inc. **Service Request:** K1704471
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Surrogate Recovery Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3546 **Units:** Percent
Analysis Method: 8270D SIM **Level:** Low

Sample Name	Lab Code	Sur1	Sur2	Sur3
Batch QC	K1704415-001	87	109	106
SED17-22	K1704471-001	70	87	88
SED17-21	K1704471-002	75	95	93
SED17-20	K1704471-003	76	98	94
SED17-18	K1704471-004	81	105	102
DUP-2	K1704471-005	82	103	101
SED17-19	K1704471-006	82	106	105
SED17-24	K1704471-007	77	85	92
SED17-28	K1704471-008	77	85	90
Method Blank	KWG1703683-5	72	77	87
Batch QCMS	KWG1703683-1	86	113 *	107
Batch QCDMS	KWG1703683-2	90	118 *	114 *
Lab Control Sample	KWG1703683-3	76	87	89
Duplicate Lab Control Sample	KWG1703683-4	75	84	86

Surrogate Recovery Control Limits (%)

Sur1	= Fluorene-d10	38-104
Sur2	= Fluoranthene-d10	39-109
Sur3	= Terphenyl-d14	38-113

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704471
Project:	Skagway-Sediment 2017/1657231	**Date Extracted:**	05/08/2017
Sample Matrix:	Sediment	**Date Analyzed:**	05/10/2017

Matrix Spike/Duplicate Matrix Spike Summary
Polynuclear Aromatic Hydrocarbons

Sample Name:	Batch QC	**Units:**	ug/Kg
Lab Code:	K1704415-001	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM	**Extraction Lot:**	KWG1703683

		Batch QCMS KWG1703683-1 **Matrix Spike**			Batch QCDMS KWG1703683-2 **Duplicate Matrix Spike**					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	ND	751	1000	75	772	1010	77	29-88	3	40
2-Methylnaphthalene	ND	751	1000	75	785	1010	78	28-98	4	40
Acenaphthylene	ND	762	1000	76	793	1010	79	32-97	4	40
Acenaphthene	ND	791	1000	79	814	1010	81	30-101	3	40
Dibenzofuran	ND	811	1000	81	834	1010	83	28-105	3	40
Fluorene	ND	819	1000	82	864	1010	86	23-116	5	40
Phenanthrene	12	1150	1000	114	947	1010	93	10-128	19	40
Anthracene	11	853	1000	84	1030	1010	101	27-116	19	40
Fluoranthene	58	1790	1000	174 *	1110	1010	105	10-138	47 *	40
Pyrene	78	1380	1000	130	1050	1010	97	16-134	27	40
Benz(a)anthracene	37	948	1000	91	1000	1010	96	27-127	6	40
Chrysene	37	988	1000	95	1080	1010	103	25-132	9	40
Benzo(b)fluoranthene	37	1010	1000	97	1060	1010	102	21-130	5	40
Benzo(k)fluoranthene	16	967	1000	95	1010	1010	99	22-126	5	40
Benzo(a)pyrene	23	872	1000	85	955	1010	93	25-129	9	40
Indeno(1,2,3-cd)pyrene	ND	932	1000	93	987	1010	98	17-138	6	40
Dibenz(a,h)anthracene	ND	961	1000	96	1020	1010	102	32-116	6	40
Benzo(g,h,i)perylene	14	1010	1000	100	1050	1010	103	17-130	4	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Soil

Service Request: K1704471
Date Extracted: 05/08/2017
Date Analyzed: 05/10/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3546
Analysis Method: 8270D SIM

Units: ug/Kg
Basis: Dry
Level: Low
Extraction Lot: KWG1703683

	Lab Control Sample KWG1703683-3 **Lab Control Spike**			Duplicate Lab Control Sample KWG1703683-4 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	356	500	71	373	500	75	42-88	5	40
2-Methylnaphthalene	358	500	72	373	500	75	43-92	4	40
Acenaphthylene	359	500	72	382	500	76	44-93	6	40
Acenaphthene	361	500	72	385	500	77	44-95	6	40
Dibenzofuran	366	500	73	388	500	78	44-96	6	40
Fluorene	364	500	73	386	500	77	45-98	6	40
Phenanthrene	371	500	74	389	500	78	41-99	5	40
Anthracene	376	500	75	394	500	79	46-100	5	40
Fluoranthene	399	500	80	412	500	82	49-102	3	40
Pyrene	392	500	78	406	500	81	48-104	4	40
Benz(a)anthracene	395	500	79	407	500	81	52-105	3	40
Chrysene	414	500	83	428	500	86	51-110	3	40
Benzo(b)fluoranthene	422	500	84	433	500	87	52-114	3	40
Benzo(k)fluoranthene	431	500	86	445	500	89	52-112	3	40
Benzo(a)pyrene	400	500	80	409	500	82	52-111	2	40
Indeno(1,2,3-cd)pyrene	379	500	76	382	500	76	44-117	1	40
Dibenz(a,h)anthracene	379	500	76	391	500	78	44-110	3	40
Benzo(g,h,i)perylene	417	500	83	426	500	85	45-107	2	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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June 01, 2017

Analytical Report for Service Request No: K1704473

Tamra Reynolds
Golder Associates Ltd.
Suite 201C, 170 Titanium Way
Whitehorse, YT Y1A0G1

RE: Skagway-Sediment 2017 / 1657231

Dear Tamra,

Enclosed are the results of the sample(s) submitted to our laboratory May 05, 2017
For your reference, these analyses have been assigned our service request number **K1704473.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3364. You may also contact me via email at howard.holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Howard Holmes
Project Manager

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Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- E The result is an estimate amount because the value exceeded the instrument calibration range.
- J The result is an estimated value.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.
- H The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

- # The control limit criteria is not applicable. See case narrative.
- J The result is an estimated value.
- E The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
- M The duplicate injection precision was not met.
- N The Matrix Spike sample recovery is not within control limits. See case narrative.
- S The reported value was determined by the Method of Standard Additions (MSA).
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- W The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- + The correlation coefficient for the MSA is less than 0.995.
- Q See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- A A tentatively identified compound, a suspected aldol-condensation product.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- C The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
- D The reported result is from a dilution.
- E The result is an estimated value.
- J The result is an estimated value.
- N The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
- P The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

- F The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
- L The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
- H The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
- O The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
- Y The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
- Z The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEH	http://dec.alaska.gov/eh/lab/cs/csapproval.htm	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	http://health.hawaii.gov/	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/page/la-lab-accreditation	03016
Maine DHS	http://www.maine.gov/dhhs/	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/enforcement/oqa.html	WA005
New York - DOH	https://www.wadsworth.org/regulatory/elap	12060
North Carolina DEQ	https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/EnvironmentalLabCertification/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water-	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

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ALS ENVIRONMENTAL

Client:	Golder Associates, Inc.	**Service Request No.:**	K1704473
Project:	Skagway - Sediment 2017/ 1657231	**Date Received:**	05/05/17
Sample Matrix:	Sediment		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt

Eight sediment samples were received for analysis at ALS Environmental on 05/05/17. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry Parameters

Acid-Volatile Sulfide by EPA Method 821/R-91-100:
The matrix spike recoveries for sample Batch QC were outside control criteria because of suspected matrix interference. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. . No further corrective action was taken.

No other anomalies associated with the analysis of these samples were observed.

Total Metals

No anomalies associated with the analysis of these samples were observed.

Diesel and Residual Range Organics by Method AK102/ AK103

The recovery of n-Triacontane and o-Terphenyl in Continuing Calibration Verification (CCV) KWG1704203-3 were outside the control criteria of ± 20% listed in the analytical report. The recovery of the analyte was within the 60-120% control criteria for surrogate recoveries in laboratory quality control samples specified in the AK102/103 method. No further corrective action was necessary.

No other anomalies associated with the analysis of these samples were observed.

Approved by_________________________________

Chain of Custody

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K1704473

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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 - 593816

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates LTD
Contact:	Tamra Reynolds
Phone:	1-867-334-4468
	Company address below will appear on the final report
Street:	170-2016 Titanium Way
City/Province:	Whitehorse, Yukon
Postal Code:	Y1A 0G1

Invoice To	
Same as Report To	☑ YES ☐ NO
Copy of Invoice with Report	☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax TJREYNOLDS@golder.com
Email 2 PADDY_MCMANUS@golder.com
Email 3 VMERCER@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax same as report
Email 2

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☑ ; 3 day [P3] ☐ ; 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ ; Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: 41037
Job #: 1657231
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Poyfair | Sampler: BW/JM

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals	PAHs	Grainsize (GS)	Total Organic Carbon (TOC)	DRO	AVS/SEM	Number of Containers
	SED17-22	01-MAY-17	13:00	Sediment	X	X	X	X			4
	SED17-21	↓	16:00	↓	↓	↓	↓	↓			↓
	SED17-20	↓	18:00	↓	↓	↓	↓	↓			↓
	SED17-18	02-MAY-17	11:00	↓	↓	↓	↓	↓			↓
	DUP-2	↓	12:00	↓	↓	↓	↓	↓			↓
	SED17-19	↓	13:00	↓	↓	↓	↓	↓			↓
	SED17-24	↓	16:00	↓	↓	↓	↓	↓			↓
	SED17-28	↓	17:00	↓	↓	↓	↓	↓			↓

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Please archive unused samples. 5-day turnaround on metals and PAHs, regular turnaround on GS & TOC. Wait for direction for DRO and AVS/SEM.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ ; SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ ; Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 4 MAY 17	Time: 6:00	Received by: [signature]	Date: 5/5/17	Time: 0840	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

PC HH

Cooler Receipt and Preservation Form

Client Golder Assc. Service Request K17 04473

Received: 5/5/17 Opened: 5/5/17 By: [signature] Unloaded: 5/5/17 By: [signature]

1. Samples were received via? *USPS* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* NA
3. Were custody seals on coolers? NA Y N If yes, how many and where? one, front

   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
0.8	0.7	—	—	-0.1	373		027 JNU 3174 5033	

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* box
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA Y N

   If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

RUSH

Notes, Discrepancies, & Resolutions:

7/25/16

Page ____ *of* ____

Total Solids

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ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment
Analysis Method: 160.3 Modified
Prep Method: None

Service Request: K1704473
Date Collected: 05/01/17 - 05/02/17
Date Received: 05/5/17
Units: Percent
Basis: As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
SED17-22	K1704473-001	**63.5**	-	1	05/05/17 17:28	
SED17-21	K1704473-002	**62.8**	-	1	05/05/17 17:28	
SED17-20	K1704473-003	**53.1**	-	1	05/05/17 17:28	
SED17-18	K1704473-004	**67.0**	-	1	05/05/17 17:28	
DUP-2	K1704473-005	**68.1**	-	1	05/05/17 17:28	
SED17-19	K1704473-006	**59.5**	-	1	05/05/17 17:28	
SED17-24	K1704473-007	**76.4**	-	1	05/05/17 17:28	
SED17-28	K1704473-008	**69.9**	-	1	05/05/17 17:28	

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Batch QC	K1704419-003DUP	-	57.3	57.2	57.3	<1	20	05/05/17
Duplicate	K1704473-006DUP	-	59.5	59.5	59.5	<1	20	05/05/17
Batch QC	K1704476-002DUP	-	81.4	85.3	83.4	5	20	05/05/17

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

General Chemistry

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ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/17 - 05/02/17
Sample Matrix:	Sediment	**Date Received:**	05/5/17
Analysis Method:	821/R-91-100	**Units:**	uMole/g
Prep Method:	Method	**Basis:**	Dry

Sulfide, Acid-Volatile

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Date Extracted	Q
SED17-22	K1704473-001	**3.58**	0.92	20	05/12/17 23:43	5/12/17	
SED17-18	K1704473-004	**2.43**	0.86	20	05/12/17 23:43	5/12/17	
SED17-24	K1704473-007	**0.105**	0.040	1	05/12/17 23:43	5/12/17	
SED17-28	K1704473-008	**0.198**	0.033	1	05/12/17 23:43	5/12/17	
Method Blank	K1704473-MB	ND U	0.016	1	05/12/17 23:43	5/12/17	

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
		Date Analyzed:	05/12/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	Batch QC	**Units:**	uMole/g
Lab Code:	K1704419-003	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1704419-003DUP Result	Average	RPD	RPD Limit
Sulfide, Acid-Volatile	821/R-91-100	0.97	8.39	8.82	8.61	5	45

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 5/24/2017 11:41:17 AM   Superset Reference:17-0000420869 rev 00

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	N/A
Sample Matrix:	Sediment	**Date Received:**	N/A
		Date Analyzed:	05/12/17
		Date Extracted:	05/12/17

Duplicate Matrix Spike Summary
Sulfide, Acid-Volatile

Sample Name:	Batch QC	**Units:**	uMole/g
Lab Code:	K1704419-003	**Basis:**	Dry
Analysis Method:	821/R-91-100		
Prep Method:	Method		

		Matrix Spike K1704419-003MS			Duplicate Matrix Spike K1704419-003DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Sulfide, Acid-Volatile	8.39	61.8	35.3	151 *	63.2	35.6	154 *	56-142	2	45

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/12/17
Sample Matrix:	Sediment	**Date Extracted:**	05/12/17

Lab Control Sample Summary
Sulfide, Acid-Volatile

Analysis Method:	821/R-91-100	**Units:**	uMole/g
Prep Method:	Method	**Basis:**	Dry
		Analysis Lot:	545571

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1704473-LCS	0.210	0.228	92	60-115

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/1/2017
Sample Matrix:	Sediment	**Date Received:**	5/5/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-22
Lab Code: K1704473-001

Sand Fraction: Weight (Grams)	6.7250
Sand Fraction: Weight Recovered (Grams)	6.6555
Sand Fraction: Percent Recovery	98.97

Weight as received (Grams)	38.348
Percent Solids	63.5
Weight Oven-Dried (Grams)	24.3510

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.0000	0.00
Gravel, Fine	2.00 mm	10	0.4633	1.90
Sand, Very Coarse	0.850 mm	20	0.6315	2.59
Sand, Coarse	0.425 mm	40	0.9489	3.90
Sand, Medium	0.250 mm	60	0.9892	4.06
Sand, Fine	0.106 mm	140	1.3619	5.59
Sand, Very Fine	0.075 mm	200	1.7449	7.17
Silt			12.0750	49.59
Clay			5.5150	22.65
		Total	23.7297	97.45

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/1/2017
Sample Matrix:	Sediment	**Date Received:**	5/5/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-21
Lab Code: K1704473-002

Sand Fraction: Weight (Grams)	6.9507
Sand Fraction: Weight Recovered (Grams)	6.9271
Sand Fraction: Percent Recovery	99.66

Weight as received (Grams)	31.656
Percent Solids	62.8
Weight Oven-Dried (Grams)	19.8800

Description	**Sieve Size**	**Sieve Number**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	4.75 mm	4	0.0283	0.14
Gravel, Fine	2.00 mm	10	0.4600	2.31
Sand, Very Coarse	0.850 mm	20	0.9082	4.57
Sand, Coarse	0.425 mm	40	1.1315	5.69
Sand, Medium	0.250 mm	60	0.9715	4.89
Sand, Fine	0.106 mm	140	1.3324	6.70
Sand, Very Fine	0.075 mm	200	1.2446	6.26
Silt			8.2200	41.35
Clay			4.6750	23.52
		Total	18.9715	95.43

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/1/2017
Sample Matrix:	Sediment	**Date Received:**	5/5/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-20
Lab Code: K1704473-003

Sand Fraction: Weight (Grams)	10.9419
Sand Fraction: Weight Recovered (Grams)	10.8900
Sand Fraction: Percent Recovery	99.53

Weight as received (Grams)	50.345
Percent Solids	53.1
Weight Oven-Dried (Grams)	26.7332

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	5.9121	22.12
Gravel, Fine	2.00 mm	10	1.5589	5.83
Sand, Very Coarse	0.850 mm	20	0.6553	2.45
Sand, Coarse	0.425 mm	40	0.4203	1.57
Sand, Medium	0.250 mm	60	0.2743	1.03
Sand, Fine	0.106 mm	140	0.7233	2.71
Sand, Very Fine	0.075 mm	200	0.9019	3.37
Silt			14.6650	54.86
Clay			2.6050	9.74
		Total	27.7161	103.68

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/2/2017
Sample Matrix:	Sediment	**Date Received:**	5/5/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-18
Lab Code: K1704473-004

Sand Fraction: Weight (Grams)	12.4974
Sand Fraction: Weight Recovered (Grams)	12.4000
Sand Fraction: Percent Recovery	99.22

Weight as received (Grams)	37.433
Percent Solids	67.0
Weight Oven-Dried (Grams)	25.0801

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	1.4720	5.87
Gravel, Fine	2.00 mm	10	0.3719	1.48
Sand, Very Coarse	0.850 mm	20	0.3202	1.28
Sand, Coarse	0.425 mm	40	0.8569	3.42
Sand, Medium	0.250 mm	60	2.0109	8.02
Sand, Fine	0.106 mm	140	4.7678	19.01
Sand, Very Fine	0.075 mm	200	2.2278	8.88
Silt			9.2000	36.68
Clay			3.3750	13.46
		Total	24.6025	98.10

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dba ALS Environmental
Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/2/2017
Sample Matrix:	Sediment	**Date Received:**	5/5/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: DUP-2
Lab Code: K1704473-005

Sand Fraction: Weight (Grams)	11.4415
Sand Fraction: Weight Recovered (Grams)	11.3894
Sand Fraction: Percent Recovery	99.54

Weight as received (Grams)	36.274
Percent Solids	68.1
Weight Oven-Dried (Grams)	24.7026

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.1493	0.60
Gravel, Fine	2.00 mm	10	0.1761	0.71
Sand, Very Coarse	0.850 mm	20	0.2383	0.96
Sand, Coarse	0.425 mm	40	0.9900	4.01
Sand, Medium	0.250 mm	60	2.4504	9.92
Sand, Fine	0.106 mm	140	4.9332	19.97
Sand, Very Fine	0.075 mm	200	2.0430	8.27
Silt			8.8900	35.99
Clay			3.4100	13.80
		Total	23.2803	94.23

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/2/2017
Sample Matrix:	Sediment	**Date Received:**	5/5/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-19
Lab Code: K1704473-006

Sand Fraction: Weight (Grams)	4.6818
Sand Fraction: Weight Recovered (Grams)	4.6789
Sand Fraction: Percent Recovery	99.94

Weight as received (Grams)	31.3
Percent Solids	59.5
Weight Oven-Dried (Grams)	18.6235

Description	**Sieve Size**	**Sieve Number**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	4.75 mm	4	0.0741	0.40
Gravel, Fine	2.00 mm	10	0.1292	0.69
Sand, Very Coarse	0.850 mm	20	0.1525	0.82
Sand, Coarse	0.425 mm	40	0.1887	1.01
Sand, Medium	0.250 mm	60	0.3280	1.76
Sand, Fine	0.106 mm	140	1.8825	10.11
Sand, Very Fine	0.075 mm	200	1.5770	8.47
Silt			10.0600	54.02
Clay			3.6450	19.57
		Total	18.0370	96.85

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/2/2017
Sample Matrix:	Sediment	**Date Received:**	5/5/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-24
Lab Code: K1704473-007

Sand Fraction: Weight (Grams)	20.9213
Sand Fraction: Weight Recovered (Grams)	20.8090
Sand Fraction: Percent Recovery	99.46

Weight as received (Grams)	64.811
Percent Solids	76.4
Weight Oven-Dried (Grams)	49.5156

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	1.7298	3.49
Gravel, Fine	2.00 mm	10	0.9152	1.85
Sand, Very Coarse	0.850 mm	20	1.1347	2.29
Sand, Coarse	0.425 mm	40	2.8601	5.78
Sand, Medium	0.250 mm	60	3.3063	6.68
Sand, Fine	0.106 mm	140	4.8102	9.71
Sand, Very Fine	0.075 mm	200	4.5000	9.09
Silt			23.1700	46.79
Clay			4.6450	9.38
		Total	47.0713	95.06

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/2/2017
Sample Matrix:	Sediment	**Date Received:**	5/5/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-28
Lab Code: K1704473-008

Sand Fraction: Weight (Grams)	15.7086
Sand Fraction: Weight Recovered (Grams)	15.5703
Sand Fraction: Percent Recovery	99.12

Weight as received (Grams)	50.36
Percent Solids	69.9
Weight Oven-Dried (Grams)	35.2016

Description	**Sieve Size**	**Sieve Number**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	4.75 mm	4	0.0090	0.03
Gravel, Fine	2.00 mm	10	0.1052	0.30
Sand, Very Coarse	0.850 mm	20	0.4653	1.32
Sand, Coarse	0.425 mm	40	0.4400	1.25
Sand, Medium	0.250 mm	60	0.3260	0.93
Sand, Fine	0.106 mm	140	5.8790	16.70
Sand, Very Fine	0.075 mm	200	6.0460	17.18
Silt			17.3800	49.37
Clay			1.4800	4.20
		Total	32.1305	91.28

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/1/2017
Sample Matrix:	Sediment	**Date Received:**	5/5/2017
		Date Analyzed:	5/8/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-22
Lab Code: K1704473-001DUP

Sand Fraction: Weight (Grams)	6.2736
Sand Fraction: Weight Recovered (Grams)	6.2280
Sand Fraction: Percent Recovery	99.27

Weight as received (Grams)	34.952
Percent Solids	63.5
Weight Oven-Dried (Grams)	22.1945

Description	**Sieve Size**	**Sieve Number**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	4.75 mm	4	0.0900	0.41
Gravel, Fine	2.00 mm	10	0.3839	1.73
Sand, Very Coarse	0.850 mm	20	0.5504	2.48
Sand, Coarse	0.425 mm	40	0.8757	3.95
Sand, Medium	0.250 mm	60	0.9816	4.42
Sand, Fine	0.106 mm	140	1.2516	5.64
Sand, Very Fine	0.075 mm	200	1.3380	6.03
Silt			10.9100	49.16
Clay			5.1150	23.05
		Total	21.4962	96.87

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/17 - 05/02/17
Sample Matrix:	Sediment	**Date Received:**	05/5/17
Analysis Method:	Walkley-Black	**Units:**	mg/Kg
Prep Method:	None	**Basis:**	Dry

Carbon, Total Organic

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
SED17-22	K1704473-001	**9600**	3100	1	05/11/17 15:00	
SED17-21	K1704473-002	**8300**	3200	1	05/11/17 15:00	
SED17-20	K1704473-003	**13700**	3700	1	05/11/17 15:00	
SED17-18	K1704473-004	**10300**	2900	1	05/11/17 15:00	
DUP-2	K1704473-005	**10000**	2900	1	05/11/17 15:00	
SED17-19	K1704473-006	**10600**	3300	1	05/11/17 15:00	
SED17-24	K1704473-007	**3500**	2600	1	05/11/17 15:00	
SED17-28	K1704473-008	**6500**	2700	1	05/11/17 15:00	
Method Blank	K1704473-MB	ND U	2000	1	05/11/17 15:00	

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/17
Sample Matrix:	Sediment	**Date Received:**	05/05/17
		Date Analyzed:	05/11/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	SED17-22	**Units:**	mg/Kg
Lab Code:	K1704473-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1704473-001DUP Result	Average	RPD	RPD Limit
Carbon, Total Organic	Walkley-Black	3100	9600	9300	9450	3	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/11/17
Sample Matrix:	Sediment	**Date Extracted:**	NA

Lab Control Sample Summary
Carbon, Total Organic

Analysis Method:	Walkley-Black	**Units:**	mg/Kg
Prep Method:	None	**Basis:**	Dry
		Analysis Lot:	545360

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1704473-LCS	5800	5400	107	85-115

Metals

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704473
Project No.: 1657231
Date Collected: 5/1/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/5/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-22
Lab Code: K1704473-001

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.009	1.0	05/12/17	05/17/17	0.009	U	
Arsenic	6010C	0.014	1.0	05/12/17	05/17/17	0.014	U	
Cadmium	6010C	0.0006	1.0	05/12/17	05/17/17	0.0026		
Chromium	6010C	0.006	1.0	05/12/17	05/17/17	0.046		
Copper	6010C	0.006	1.0	05/12/17	05/17/17	0.150		
Lead	6010C	0.003	1.0	05/12/17	05/17/17	0.318		
Mercury	7470A	0.00011	4.0	05/12/17	05/18/17	0.00011	U	
Nickel	6010C	0.003	1.0	05/12/17	05/17/17	0.042		
Silver	6010C	0.003	1.0	05/12/17	05/17/17	0.003	U	
Zinc	6010C	0.009	1.0	05/12/17	05/17/17	1.310		

% Solids: 63.5

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704473
Project No.: 1657231
Date Collected: 5/2/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/5/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-18 **Lab Code:** K1704473-004

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.008	1.0	05/12/17	05/17/17	0.008	U	
Arsenic	6010C	0.013	1.0	05/12/17	05/17/17	0.013	U	
Cadmium	6010C	0.0005	1.0	05/12/17	05/17/17	0.0008		
Chromium	6010C	0.005	1.0	05/12/17	05/17/17	0.018		
Copper	6010C	0.005	1.0	05/12/17	05/17/17	0.041		
Lead	6010C	0.003	1.0	05/12/17	05/17/17	0.141		
Mercury	7470A	0.00011	4.0	05/12/17	05/18/17	0.00011	U	
Nickel	6010C	0.003	1.0	05/12/17	05/17/17	0.016		
Silver	6010C	0.003	1.0	05/12/17	05/17/17	0.003	U	
Zinc	6010C	0.008	1.0	05/12/17	05/17/17	0.469		

% Solids: 67.0

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704473
Project No.: 1657231
Date Collected: 5/2/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/5/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-24
Lab Code: K1704473-007

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.008	1.0	05/12/17	05/17/17	0.008	U	
Arsenic	6010C	0.013	1.0	05/12/17	05/17/17	0.013	U	
Cadmium	6010C	0.0005	1.0	05/12/17	05/17/17	0.0005	U	
Chromium	6010C	0.005	1.0	05/12/17	05/17/17	0.016		
Copper	6010C	0.005	1.0	05/12/17	05/17/17	0.025		
Lead	6010C	0.003	1.0	05/12/17	05/17/17	0.018		
Mercury	7470A	0.00010	4.0	05/12/17	05/18/17	0.00010	U	
Nickel	6010C	0.003	1.0	05/12/17	05/17/17	0.014		
Silver	6010C	0.003	1.0	05/12/17	05/17/17	0.003	U	
Zinc	6010C	0.008	1.0	05/12/17	05/17/17	0.139		

% Solids: 76.4

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704473
Project No.: 1657231
Date Collected: 5/2/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/5/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-28
Lab Code: K1704473-008

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.006	1.0	05/12/17	05/17/17	0.006	U	
Arsenic	6010C	0.010	1.0	05/12/17	05/17/17	0.010	U	
Cadmium	6010C	0.0004	1.0	05/12/17	05/17/17	0.0004	U	
Chromium	6010C	0.004	1.0	05/12/17	05/17/17	0.018		
Copper	6010C	0.004	1.0	05/12/17	05/17/17	0.017		
Lead	6010C	0.002	1.0	05/12/17	05/17/17	0.008		
Mercury	7470A	0.00008	4.0	05/12/17	05/18/17	0.00008	U	
Nickel	6010C	0.002	1.0	05/12/17	05/17/17	0.014		
Silver	6010C	0.002	1.0	05/12/17	05/17/17	0.002	U	
Zinc	6010C	0.006	1.0	05/12/17	05/17/17	0.108		

% Solids: 69.9

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc. **Service Request:** K1704473
Project No.: 1657231 **Date Collected:**
Project Name: Skagway-Sediment 2017 **Date Received:**
Matrix: SEDIMENT **Units:** uMole/g
Basis: DRY

Sample Name: Method Blank **Lab Code:** K1704473-MB

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.003	1.0	05/12/17	05/17/17	0.003	U	
Arsenic	6010C	0.005	1.0	05/12/17	05/17/17	0.005	U	
Cadmium	6010C	0.0002	1.0	05/12/17	05/17/17	0.0002	U	
Chromium	6010C	0.002	1.0	05/12/17	05/17/17	0.002	U	
Copper	6010C	0.002	1.0	05/12/17	05/17/17	0.002	U	
Lead	6010C	0.001	1.0	05/12/17	05/17/17	0.001	U	
Nickel	6010C	0.001	1.0	05/12/17	05/17/17	0.001	U	
Silver	6010C	0.001	1.0	05/12/17	05/17/17	0.001	U	
Zinc	6010C	0.003	1.0	05/12/17	05/17/17	0.003	U	

% Solids: 100.0

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704473
Project No.: 1657231
Date Collected:
Project Name: Skagway-Sediment 2017
Date Received:
Matrix: SEDIMENT
Units: umol/g
Basis: DRY

Sample Name: Method Blank
Lab Code: KQ1705983-01

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Mercury	7470A	0.00004	4.0	05/12/17	05/18/17	0.00004	U	

% Solids: 100.0

Comments:

Simultaneously Extactable Metals

- 5A -

SPIKE SAMPLE RECOVERY

Client: Golder Associates, Inc. **Service Request:** K1704473

Project No.: 1657231 **Units:** UMOLE/G

Project Name: Skagway-Sediment 2017 **Basis:** DRY

Matrix: SEDIMENT **% Solids:** 57.3

Sample Name: Batch QC1S **Lab Code:** K1704419-003S

Analyte	Control Limit %R	Spike Result	C	Sample Result	C	Spike Added	%R	Q	Method
Antimony	75 - 125	0.112		0.009	U	0.127	88		6010C
Arsenic	75 - 125	0.978		0.015	U	1.031	95		6010C
Cadmium	75 - 125	0.3841		0.0022		0.343	111		6010C
Chromium	75 - 125	0.3294		0.0277		0.297	102		6010C
Copper	75 - 125	0.380		0.122		0.304	85		6010C
Lead	75 - 125	1.097		0.706		0.374	105		6010C
Mercury	75 - 125	0.00315		0.00012	U	0.00308	102		7470A
Nickel	75 - 125	0.776		0.029		0.655	114		6010C
Silver	75 - 125	0.160		0.003	U	0.179	89		6010C
Zinc	75 - 125	1.889		1.275		0.590	104		6010C

An empty field in the Control Limit column indicates the control limit is not applicable

Simultaneouslv Extactable Metals

- 6 -
DUPLICATES

Client: Golder Associates, Inc. **Service Request:** K1704473

Project No.: 1657231 **Units:** UMOLE/G

Project Name: Skagway-Sediment 2017 **Basis:** DRY

Matrix: SEDIMENT **% Solids:** 57.3

Sample Name: Batch QC1D **Lab Code:** K1704419-003D

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	Method
Antimony		0.009	U	0.009	U			6010C
Arsenic		0.015	U	0.015	U			6010C
Cadmium		0.0022		0.0018		20.0		6010C
Chromium		0.0277		0.0244		12.7		6010C
Copper	30	0.122		0.095		24.9		6010C
Lead	30	0.706		0.607		15.1		6010C
Mercury		0.00012	U	0.00012	U			7470A
Nickel	30	0.029		0.026		10.9		6010C
Silver		0.003	U	0.003	U			6010C
Zinc	30	1.275		1.142		11.0		6010C

An empty field in the Control Limit column indicates the control limit is not applicable.

Simultaneously Extactable Metals
-7-
LABORATORY CONTROL SAMPLE

Client: Golder Associates, Inc. **Service Request:** K1704473

Project No.: 1657231

Project Name: Skagway-Sediment 2017

Aqueous LCS Source: **ALS MIXED** **Solid LCS Source:**

Analyte	Aqueous (umol/L) True	Aqueous (umol/L) Found	Aqueous (umol/L) %R	Solid (mg/kg) True	Solid (mg/kg) Found	C	Limits		%R
Antimony	4.100	3.865	94						
Arsenic	33.400	32.912	99						
Cadmium	11.100	11.009	99						
Chromium	9.610	10.125	105						
Copper	9.830	8.848	90						
Lead	12.100	11.741	97						
Mercury	0.09960	0.10280	103						
Nickel	21.200	21.610	102						
Silver	5.790	5.522	95						
Zinc	19.100	18.883	99						

Diesel and Residual Range Organics

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/01/2017
Sample Matrix:	Sediment	**Date Received:**	05/05/2017

Diesel and Residual Range Organics

Sample Name:	SED17-22	**Units:**	mg/Kg
Lab Code:	K1704473-001	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	31	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	160	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	92	50-150	05/17/17	Acceptable
n-Triacontane	94	50-150	05/17/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/02/2017
Sample Matrix:	Sediment	**Date Received:**	05/05/2017

Diesel and Residual Range Organics

Sample Name:	SED17-18	**Units:**	mg/Kg
Lab Code:	K1704473-004	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	**38**	Z	30	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	150	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	87	50-150	05/17/17	Acceptable
n-Triacontane	88	50-150	05/17/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/02/2017
Sample Matrix:	Sediment	**Date Received:**	05/05/2017

Diesel and Residual Range Organics

Sample Name:	SED17-24	**Units:**	mg/Kg
Lab Code:	K1704473-007	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	26	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	130	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	89	50-150	05/17/17	Acceptable
n-Triacontane	90	50-150	05/17/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/02/2017
Sample Matrix:	Sediment	**Date Received:**	05/05/2017

Diesel and Residual Range Organics

Sample Name:	SED17-28	**Units:**	mg/Kg
Lab Code:	K1704473-008	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	29	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	150	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	85	50-150	05/17/17	Acceptable
n-Triacontane	90	50-150	05/17/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA

Diesel and Residual Range Organics

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1703859-5	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	20	1	05/12/17	05/17/17	KWG1703859	
C25 - C36 RRO	ND	U	98	1	05/12/17	05/17/17	KWG1703859	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	75	50-150	05/17/17	Acceptable
n-Triacontane	78	50-150	05/17/17	Acceptable

Comments:

Client: Golder Associates, Inc.
Service Request: K1704473
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Surrogate Recovery Summary
Diesel and Residual Range Organics

Extraction Method: EPA 3550B
Units: Percent
Analysis Method: AK 102.0/103.0
Level: Low

Sample Name	Lab Code	Sur1	Sur2
Batch QC	K1704419-006	71	76
SED17-22	K1704473-001	92	94
SED17-18	K1704473-004	87	88
SED17-24	K1704473-007	89	90
SED17-28	K1704473-008	85	90
Method Blank	KWG1703859-5	75	78
Batch QCMS	KWG1703859-1	78	79
Batch QCDMS	KWG1703859-2	79	83
Lab Control Sample	KWG1703859-3	93	95
Duplicate Lab Control Sample	KWG1703859-4	105	100

Surrogate Recovery Control Limits (%)

Sur1	=	o-Terphenyl	50-150
Sur2	=	n-Triacontane	50-150

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704473
Project:	Skagway-Sediment 2017/1657231	**Date Extracted:**	05/12/2017
Sample Matrix:	Sediment	**Date Analyzed:**	05/17/2017

Matrix Spike/Duplicate Matrix Spike Summary
Diesel and Residual Range Organics

Sample Name:	Batch QC	**Units:**	mg/Kg
Lab Code:	K1704419-006	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0	**Extraction Lot:**	KWG1703859

		Batch QCMS KWG1703859-1 **Matrix Spike**			Batch QCDMS KWG1703859-2 **Duplicate Matrix Spike**					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
C10 - C25 DRO	ND	266	327	81	259	328	79	60-140	3	50
C25 - C36 RRO	ND	160	163	98	159	164	97	60-140	0	50

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

QA/QC Report

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704473
Date Extracted: 05/12/2017
Date Analyzed: 05/17/2017 - 05/24/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Diesel and Residual Range Organics

Extraction Method: EPA 3550B
Analysis Method: AK 102.0/103.0

Units: mg/Kg
Basis: Dry
Level: Low
Extraction Lot: KWG1703859

	Lab Control Sample KWG1703859-3 **Lab Control Spike**			Duplicate Lab Control Sample KWG1703859-4 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
C10 - C25 DRO	251	267	94	245	267	92	75-125	2	20
C25 - C36 RRO	140	133	105	154	133	116	60-120	10	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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May 22, 2017

Analytical Report for Service Request No: K1704542

Tamra Reynolds
Golder Associates Ltd.
Suite 201C, 170 Titanium Way
Whitehorse, YT Y1A0G1

RE: Skagway-Sediment 2017 / 1657231

Dear Tamra,

Enclosed are the results of the sample(s) submitted to our laboratory May 08, 2017
For your reference, these analyses have been assigned our service request number **K1704542.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3364. You may also contact me via email at howard.holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Howard Holmes
Project Manager

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Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- E The result is an estimate amount because the value exceeded the instrument calibration range.
- J The result is an estimated value.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.
- H The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

- # The control limit criteria is not applicable. See case narrative.
- J The result is an estimated value.
- E The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
- M The duplicate injection precision was not met.
- N The Matrix Spike sample recovery is not within control limits. See case narrative.
- S The reported value was determined by the Method of Standard Additions (MSA).
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- W The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- + The correlation coefficient for the MSA is less than 0.995.
- Q See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- A A tentatively identified compound, a suspected aldol-condensation product.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- C The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
- D The reported result is from a dilution.
- E The result is an estimated value.
- J The result is an estimated value.
- N The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
- P The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

- F The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
- L The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
- H The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
- O The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
- Y The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
- Z The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	Not available	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	03016
Maine DHS	Not available	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
North Carolina DWQ	http://www.dwqlab.org/	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/envserv/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS Environmental—Kelso Laboratory
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ALS ENVIRONMENTAL

Client:	Golder Associates, Inc.	**Service Request No.:**	K1704542
Project:	Skagway-Sediment 2017/ 1657231	**Date Received:**	05/08/17
Sample Matrix:	Sediment		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt

Nine sediment samples were received for analysis at ALS Environmental on 05/08/17. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

Total Metals

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for the replicate analysis of Copper and Nickel in sample SED17-07 was outside the normal ALS control limits. The variability in the results was attributed to the heterogeneous character of the sample. Standard mixing techniques were used, but were not sufficient for complete homogenization of this sample.

Matrix Spike Recovery Exceptions:
The control criteria for matrix spike recovery of Aluminum Barium, Iron, and Magnesium for sample SED17-07 were not applicable. The analyte concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

Antimony recoveries are generally low for soil and sediment samples when digested using EPA Method 3050B. Despite anticipated low recoveries, the method is still generally prescribed because of its versatility for general metals analysis. Antimony results (in conjunction with the matrix spike recovery) from this procedure should only be used as indicators to estimate concentrations. The matrix spike recovery of Antimony for sample SED17-07 was below the ALS control criterion. Since low recoveries resulted from a method defect and were possibly magnified by certain matrix components, no corrective action was appropriate. Alternative procedures that specifically target Antimony are available but were not specified for this project. The associated QA/QC results (e.g. control sample, calibration standards, etc.) indicated the analysis was in control.

The matrix spike recovery of Barium and Lead for sample SED17-07 was outside control criteria. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. No further corrective action was appropriate.

No other anomalies associated with the analysis of these samples were observed.

Approved by________________________________

<u>Polynuclear Aromatic Hydrocarbons by EPA Method 8270</u>

Calibration Verification Exceptions:
The following analytes were flagged as outside the control criterion for Continuing Calibration Verification (CCV) MS11\0515F002.D and MS11\0516F002.D: Fluoranthene and Fluoranthene-d10. In accordance with the EPA Method, 80% or more of the CCV analytes must pass within 20% of the true value. The ALS SOP allows for 40% difference for the remaining analytes. The CCV met these criteria. The quality of the sample data was not significantly affected. No further corrective action was required.

Sample Notes and Discussion:
The results reported for Acenaphthylene in samples SED17-10 and SED17-15 may contain a slight bias. The chromatogram indicated the presence of non-target background components. The matrix interference may have resulted in a slight high bias in the affected samples. The results were flagged with "X" to indicate the issue.

No other anomalies associated with the analysis of these samples were observed.

Approved by____

Chain of Custody

ALS Environmental—Kelso Laboratory
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ALS Environmental
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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

K1704642

Affix ALS barcode label here (lab use only)

COC Number: 15 - 594997

Page 1 of 4

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates LTD
Contact:	Tamra Reynolds
Phone:	1-867-334-4468
	Company address below will appear on the final report
Street:	170 - 201 C Titanium Way
City/Province:	Whitehorse, Yukon
Postal Code:	Y1A 0G1
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: JREYNOLDS@golder.com
Email 2: PADDY_MCMANUS@golder.com
Email 3: VMERCER@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: same as report
Email 2:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☑ 3 day [P3] ☐ 2 day [P2] ☐
EMERGENCY: 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: 41037
Job #: 1657231
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#:
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Poyton | Sampler: PM / JM

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals	PAHs	Grainsize (GS)	Total Organic Carbon (TOC)	DRO	AVS/SEM	Number of Containers
1	SED17-07	04-MAY-17	10:00	Sediment	X	X	X	X			4
2	SED17-12	↓	12:00	↓	↓	↓	↓	↓			↓
3	DUP-3	↓	13:00	↓	↓	↓	↓	↓			↓
4	SED17-01	↓	14:40	↓	↓	↓	↓	↓			↓
5	SED17-03	↓	16:00	↓	↓	↓	↓	↓			↓
6	SED17-29	↓	1800	↓	↓	↓	↓	↓			↓
7	SED17-10	05-MAY-17	9:00	↓	↓	↓	↓	↓			↓
8	SED17-15	↓	10:00	↓	↓	↓	↓	↓			↓
9	SED17-27	↓	12:00	↓	↓	↓	↓	↓			↓
	Travel Blank	04-MAY-17	18:00	water	↓	↓					5
	FB-1	↓	18:00	↓	↓	↓					↓
	EB-1	↓	18:00	↓	↓	↓					↓

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO
Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Please archive unused samples, 5-day turnaround on metals and PAHs, regular turnaround on GS and TOC, wait for directions for DRO and AVS/SEM.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 05-MAY-17	Time: 15:00	Received by: [signature]	Date: 5/8/17	Time: 0840	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS

PC H2

Cooler Receipt and Preservation Form

Client Golder Service Request K17 C4542

Received: 5/8/17 Opened: 5/8/17 By: [illegible] Unloaded: 5/8/17 By: [illegible]

1. Samples were received via? *USPS* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* ______ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where? one, front

   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
2.1	2.1	3.4	3.4	0	298			✓
-2.1	-2.2	frozen	→	-0.1	372			

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* boxes
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA Y N

   If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions:

RUSH

7/25/16

Page ____ ***of*** ____

Total Solids

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Client: Golder Associates, Inc. **Service Request:** K1704542
Project: Skagway-Sediment 2017/1657231 **Date Collected:** 05/04/17 - 05/05/17
Sample Matrix: Sediment **Date Received:** 05/8/17

Analysis Method: 160.3 Modified **Units:** Percent
Prep Method: None **Basis:** As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
SED17-07	K1704542-001	**83.7**	-	1	05/08/17 16:10	
SED17-12	K1704542-002	**75.9**	-	1	05/08/17 16:10	
DUP-3	K1704542-003	**76.8**	-	1	05/08/17 16:10	
SED17-01	K1704542-004	**72.3**	-	1	05/08/17 16:10	
SED17-03	K1704542-005	**78.5**	-	1	05/08/17 16:10	
SED17-29	K1704542-006	**49.6**	-	1	05/08/17 16:10	
SED17-10	K1704542-007	**77.9**	-	1	05/08/17 16:10	
SED17-15	K1704542-008	**76.2**	-	1	05/08/17 16:10	
SED17-27	K1704542-009	**79.1**	-	1	05/08/17 16:10	

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	NA

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Batch QC	K1704524-001DUP	-	86.4	82.7	84.6	4	20	05/08/17

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	05/05/17
Sample Matrix:	Soil	**Date Received:**	05/08/17
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Batch QC	K1704539-001DUP	-	63.4	62.6	63.0	1	20	05/08/17
SED17-10	K1704542-007DUP	-	77.9	76.8	77.4	1	20	05/08/17

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Metals

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17 10:00
Sample Matrix:	Sediment	**Date Received:**	05/08/17 09:40
Sample Name:	SED17-07	**Basis:**	Dry
Lab Code:	K1704542-001		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**9090**		mg/Kg	2.4	2	05/11/17 11:48	05/08/17	
Antimony	6020A	ND	U	mg/Kg	0.059	5	05/11/17 09:41	05/08/17	
Arsenic	6020A	**1.82**		mg/Kg	0.59	5	05/11/17 09:41	05/08/17	
Barium	6010C	**179**		mg/Kg	0.95	2	05/11/17 11:48	05/08/17	
Beryllium	6020A	**0.161**		mg/Kg	0.024	5	05/11/17 09:41	05/08/17	
Cadmium	6020A	**0.290**		mg/Kg	0.024	5	05/11/17 09:41	05/08/17	
Calcium	6010C	**3410**		mg/Kg	4.7	2	05/11/17 11:48	05/08/17	
Chromium	6020A	**9.05**		mg/Kg	0.24	5	05/11/17 09:41	05/08/17	
Cobalt	6020A	**4.40**		mg/Kg	0.024	5	05/11/17 09:41	05/08/17	
Copper	6020A	**33.0**		mg/Kg	0.12	5	05/11/17 09:41	05/08/17	
Iron	6010C	**16800**		mg/Kg	4.7	2	05/11/17 11:48	05/08/17	
Lead	6020A	**172**		mg/Kg	0.059	5	05/11/17 09:41	05/08/17	
Magnesium	6010C	**5850**		mg/Kg	2.4	2	05/11/17 11:48	05/08/17	
Manganese	6010C	**227**		mg/Kg	0.24	2	05/11/17 11:48	05/08/17	
Mercury	7471B	**0.179**		mg/Kg	0.023	1	05/11/17 12:42	05/09/17	
Nickel	6020A	**4.55**		mg/Kg	0.24	5	05/11/17 09:41	05/08/17	
Potassium	6010C	**4100**		mg/Kg	47	2	05/11/17 11:48	05/08/17	
Selenium	6020A	ND	U	mg/Kg	1.2	5	05/11/17 09:41	05/08/17	
Silver	6020A	**0.258**		mg/Kg	0.024	5	05/11/17 09:41	05/08/17	
Sodium	6010C	**3900**		mg/Kg	47	2	05/11/17 11:48	05/08/17	
Thallium	6020A	**0.179**		mg/Kg	0.024	5	05/11/17 09:41	05/08/17	
Vanadium	6020A	**31.0**		mg/Kg	0.24	5	05/11/17 09:41	05/08/17	
Zinc	6010C	**214**		mg/Kg	1.2	2	05/11/17 11:48	05/08/17	

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Superset Reference:

Client:	Golder Associates, Inc.		**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231		**Date Collected:**	05/04/17 12:00
Sample Matrix:	Sediment		**Date Received:**	05/08/17 09:40
Sample Name:	SED17-12		**Basis:**	Dry
Lab Code:	K1704542-002			

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**7880**		mg/Kg	2.0	2	05/11/17 11:58	05/08/17	
Antimony	6020A	**0.213**		mg/Kg	0.050	5	05/11/17 10:40	05/08/17	
Arsenic	6020A	**3.76**		mg/Kg	0.50	5	05/11/17 10:40	05/08/17	
Barium	6010C	**174**		mg/Kg	0.79	2	05/11/17 11:58	05/08/17	
Beryllium	6020A	**0.136**		mg/Kg	0.020	5	05/11/17 10:40	05/08/17	
Cadmium	6020A	**1.21**		mg/Kg	0.020	5	05/11/17 10:40	05/08/17	
Calcium	6010C	**14300**		mg/Kg	4.0	2	05/11/17 11:58	05/08/17	
Chromium	6020A	**18.9**		mg/Kg	0.20	5	05/11/17 10:40	05/08/17	
Cobalt	6020A	**6.86**		mg/Kg	0.020	5	05/11/17 10:40	05/08/17	
Copper	6020A	**96.2**		mg/Kg	0.099	5	05/11/17 10:40	05/08/17	
Iron	6010C	**40600**		mg/Kg	4.0	2	05/11/17 11:58	05/08/17	
Lead	6020A	**469**		mg/Kg	0.050	5	05/11/17 10:40	05/08/17	
Magnesium	6010C	**5570**		mg/Kg	2.0	2	05/11/17 11:58	05/08/17	
Manganese	6010C	**370**		mg/Kg	0.20	2	05/11/17 11:58	05/08/17	
Mercury	7471B	**0.532**		mg/Kg	0.021	1	05/11/17 12:49	05/09/17	
Nickel	6020A	**15.0**		mg/Kg	0.20	5	05/11/17 10:40	05/08/17	
Potassium	6010C	**3730**		mg/Kg	40	2	05/11/17 11:58	05/08/17	
Selenium	6020A	ND	U	mg/Kg	0.99	5	05/11/17 10:40	05/08/17	
Silver	6020A	**0.584**		mg/Kg	0.020	5	05/11/17 10:40	05/08/17	
Sodium	6010C	**4250**		mg/Kg	40	2	05/11/17 11:58	05/08/17	
Thallium	6020A	**0.202**		mg/Kg	0.020	5	05/11/17 10:40	05/08/17	
Vanadium	6020A	**29.1**		mg/Kg	0.20	5	05/11/17 10:40	05/08/17	
Zinc	6010C	**806**		mg/Kg	0.99	2	05/11/17 11:58	05/08/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17 13:00
Sample Matrix:	Sediment	**Date Received:**	05/08/17 09:40
Sample Name:	DUP-3	**Basis:**	Dry
Lab Code:	K1704542-003		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**8420**	mg/Kg	2.0	2	05/11/17 12:01	05/08/17	
Antimony	6020A	**0.151**	mg/Kg	0.050	5	05/11/17 10:02	05/08/17	
Arsenic	6020A	**2.59**	mg/Kg	0.50	5	05/11/17 10:02	05/08/17	
Barium	6010C	**166**	mg/Kg	0.79	2	05/11/17 12:01	05/08/17	
Beryllium	6020A	**0.171**	mg/Kg	0.020	5	05/11/17 10:02	05/08/17	
Cadmium	6020A	**1.27**	mg/Kg	0.020	5	05/11/17 10:02	05/08/17	
Calcium	6010C	**6750**	mg/Kg	4.0	2	05/11/17 12:01	05/08/17	
Chromium	6020A	**11.5**	mg/Kg	0.20	5	05/11/17 10:02	05/08/17	
Cobalt	6020A	**5.46**	mg/Kg	0.020	5	05/11/17 10:02	05/08/17	
Copper	6020A	**88.9**	mg/Kg	0.099	5	05/11/17 10:02	05/08/17	
Iron	6010C	**17000**	mg/Kg	4.0	2	05/11/17 12:01	05/08/17	
Lead	6020A	**534**	mg/Kg	0.050	5	05/11/17 10:02	05/08/17	
Magnesium	6010C	**5540**	mg/Kg	2.0	2	05/11/17 12:01	05/08/17	
Manganese	6010C	**243**	mg/Kg	0.20	2	05/11/17 12:01	05/08/17	
Mercury	7471B	**0.460**	mg/Kg	0.020	1	05/11/17 12:50	05/09/17	
Nickel	6020A	**5.61**	mg/Kg	0.20	5	05/11/17 10:02	05/08/17	
Potassium	6010C	**3440**	mg/Kg	40	2	05/11/17 12:01	05/08/17	
Selenium	6020A	ND U	mg/Kg	0.99	5	05/11/17 10:02	05/08/17	
Silver	6020A	**0.571**	mg/Kg	0.020	5	05/11/17 10:02	05/08/17	
Sodium	6010C	**3640**	mg/Kg	40	2	05/11/17 12:01	05/08/17	
Thallium	6020A	**0.224**	mg/Kg	0.020	5	05/11/17 10:02	05/08/17	
Vanadium	6020A	**35.6**	mg/Kg	0.20	5	05/11/17 10:02	05/08/17	
Zinc	6010C	**776**	mg/Kg	0.99	2	05/11/17 12:01	05/08/17	

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Superset Reference:

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17 14:40
Sample Matrix:	Sediment	**Date Received:**	05/08/17 09:40
Sample Name:	SED17-01	**Basis:**	Dry
Lab Code:	K1704542-004		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**14200**		mg/Kg	2.1	2	05/11/17 12:03	05/08/17	
Antimony	6020A	**0.096**		mg/Kg	0.053	5	05/11/17 10:08	05/08/17	
Arsenic	6020A	**3.08**		mg/Kg	0.53	5	05/11/17 10:08	05/08/17	
Barium	6010C	**272**		mg/Kg	0.84	2	05/11/17 12:03	05/08/17	
Beryllium	6020A	**0.281**		mg/Kg	0.021	5	05/11/17 10:08	05/08/17	
Cadmium	6020A	**0.640**		mg/Kg	0.021	5	05/11/17 10:08	05/08/17	
Calcium	6010C	**4370**		mg/Kg	4.2	2	05/11/17 12:03	05/08/17	
Chromium	6020A	**21.1**		mg/Kg	0.21	5	05/11/17 10:08	05/08/17	
Cobalt	6020A	**8.99**		mg/Kg	0.021	5	05/11/17 10:08	05/08/17	
Copper	6020A	**24.4**		mg/Kg	0.11	5	05/11/17 10:08	05/08/17	
Iron	6010C	**24500**		mg/Kg	4.2	2	05/11/17 12:03	05/08/17	
Lead	6020A	**66.5**		mg/Kg	0.053	5	05/11/17 10:08	05/08/17	
Magnesium	6010C	**8900**		mg/Kg	2.1	2	05/11/17 12:03	05/08/17	
Manganese	6010C	**318**		mg/Kg	0.21	2	05/11/17 12:03	05/08/17	
Mercury	7471B	**0.035**		mg/Kg	0.020	1	05/11/17 12:52	05/09/17	
Nickel	6020A	**11.1**		mg/Kg	0.21	5	05/11/17 10:08	05/08/17	
Potassium	6010C	**6290**		mg/Kg	42	2	05/11/17 12:03	05/08/17	
Selenium	6020A	ND	U	mg/Kg	1.1	5	05/11/17 10:08	05/08/17	
Silver	6020A	**0.588**		mg/Kg	0.021	5	05/11/17 10:08	05/08/17	
Sodium	6010C	**5380**		mg/Kg	42	2	05/11/17 12:03	05/08/17	
Thallium	6020A	**0.337**		mg/Kg	0.021	5	05/11/17 10:08	05/08/17	
Vanadium	6020A	**64.8**		mg/Kg	0.21	5	05/11/17 10:08	05/08/17	
Zinc	6010C	**124**		mg/Kg	1.1	2	05/11/17 12:03	05/08/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17 16:00
Sample Matrix:	Sediment	**Date Received:**	05/08/17 09:40
Sample Name:	SED17-03	**Basis:**	Dry
Lab Code:	K1704542-005		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**6020**		mg/Kg	2.2	2	05/11/17 12:13	05/08/17	
Antimony	6020A	ND	U	mg/Kg	0.056	5	05/11/17 10:11	05/08/17	
Arsenic	6020A	**1.12**		mg/Kg	0.56	5	05/11/17 10:11	05/08/17	
Barium	6010C	**101**		mg/Kg	0.90	2	05/11/17 12:13	05/08/17	
Beryllium	6020A	**0.137**		mg/Kg	0.022	5	05/11/17 10:11	05/08/17	
Cadmium	6020A	**0.078**		mg/Kg	0.022	5	05/11/17 10:11	05/08/17	
Calcium	6010C	**4240**		mg/Kg	4.5	2	05/11/17 12:13	05/08/17	
Chromium	6020A	**7.22**		mg/Kg	0.22	5	05/11/17 10:11	05/08/17	
Cobalt	6020A	**4.12**		mg/Kg	0.022	5	05/11/17 10:11	05/08/17	
Copper	6020A	**10.1**		mg/Kg	0.11	5	05/11/17 10:11	05/08/17	
Iron	6010C	**11900**		mg/Kg	4.5	2	05/11/17 12:13	05/08/17	
Lead	6020A	**8.43**		mg/Kg	0.056	5	05/11/17 10:11	05/08/17	
Magnesium	6010C	**4250**		mg/Kg	2.2	2	05/11/17 12:13	05/08/17	
Manganese	6010C	**166**		mg/Kg	0.22	2	05/11/17 12:13	05/08/17	
Mercury	7471B	ND	U	mg/Kg	0.021	1	05/11/17 12:54	05/09/17	
Nickel	6020A	**4.26**		mg/Kg	0.22	5	05/11/17 10:11	05/08/17	
Potassium	6010C	**2390**		mg/Kg	45	2	05/11/17 12:13	05/08/17	
Selenium	6020A	ND	U	mg/Kg	1.1	5	05/11/17 10:11	05/08/17	
Silver	6020A	**0.044**		mg/Kg	0.022	5	05/11/17 10:11	05/08/17	
Sodium	6010C	**3250**		mg/Kg	45	2	05/11/17 12:13	05/08/17	
Thallium	6020A	**0.122**		mg/Kg	0.022	5	05/11/17 10:11	05/08/17	
Vanadium	6020A	**26.2**		mg/Kg	0.22	5	05/11/17 10:11	05/08/17	
Zinc	6010C	**40.9**		mg/Kg	1.1	2	05/11/17 12:13	05/08/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17 18:00
Sample Matrix:	Sediment	**Date Received:**	05/08/17 09:40
Sample Name:	SED17-29	**Basis:**	Dry
Lab Code:	K1704542-006		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**20500**		mg/Kg	3.2	2	05/11/17 12:16	05/08/17	
Antimony	6020A	ND	U	mg/Kg	0.080	5	05/11/17 10:25	05/08/17	
Arsenic	6020A	**5.20**		mg/Kg	0.80	5	05/11/17 10:25	05/08/17	
Barium	6010C	**409**		mg/Kg	1.3	2	05/11/17 12:16	05/08/17	
Beryllium	6020A	**0.374**		mg/Kg	0.032	5	05/11/17 10:25	05/08/17	
Cadmium	6020A	**0.564**		mg/Kg	0.032	5	05/11/17 10:25	05/08/17	
Calcium	6010C	**31200**		mg/Kg	6.4	2	05/11/17 12:16	05/08/17	
Chromium	6020A	**23.8**		mg/Kg	0.32	5	05/11/17 10:25	05/08/17	
Cobalt	6020A	**11.2**		mg/Kg	0.032	5	05/11/17 10:25	05/08/17	
Copper	6020A	**18.3**		mg/Kg	0.16	5	05/11/17 10:25	05/08/17	
Iron	6010C	**36100**		mg/Kg	6.4	2	05/11/17 12:16	05/08/17	
Lead	6020A	**17.0**		mg/Kg	0.080	5	05/11/17 10:25	05/08/17	
Magnesium	6010C	**13400**		mg/Kg	3.2	2	05/11/17 12:16	05/08/17	
Manganese	6010C	**465**		mg/Kg	0.32	2	05/11/17 12:16	05/08/17	
Mercury	7471B	**0.043**		mg/Kg	0.029	1	05/11/17 12:59	05/09/17	
Nickel	6020A	**12.7**		mg/Kg	0.32	5	05/11/17 10:25	05/08/17	
Potassium	6010C	**9140**		mg/Kg	64	2	05/11/17 12:16	05/08/17	
Selenium	6020A	ND	U	mg/Kg	1.6	5	05/11/17 10:25	05/08/17	
Silver	6020A	**0.247**		mg/Kg	0.032	5	05/11/17 10:25	05/08/17	
Sodium	6010C	**13700**		mg/Kg	64	2	05/11/17 12:16	05/08/17	
Thallium	6020A	**0.486**		mg/Kg	0.032	5	05/11/17 10:25	05/08/17	
Vanadium	6020A	**73.6**		mg/Kg	0.32	5	05/11/17 10:25	05/08/17	
Zinc	6010C	**115**		mg/Kg	1.6	2	05/11/17 12:16	05/08/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/05/17 09:00
Sample Matrix:	Sediment	**Date Received:**	05/08/17 09:40
Sample Name:	SED17-10	**Basis:**	Dry
Lab Code:	K1704542-007		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**7580**		mg/Kg	2.3	2	05/11/17 12:18	05/08/17	
Antimony	6020A	ND	U	mg/Kg	0.058	5	05/11/17 10:29	05/08/17	
Arsenic	6020A	**1.56**		mg/Kg	0.58	5	05/11/17 10:29	05/08/17	
Barium	6010C	**154**		mg/Kg	0.93	2	05/11/17 12:18	05/08/17	
Beryllium	6020A	**0.144**		mg/Kg	0.023	5	05/11/17 10:29	05/08/17	
Cadmium	6020A	**0.265**		mg/Kg	0.023	5	05/11/17 10:29	05/08/17	
Calcium	6010C	**12800**		mg/Kg	4.7	2	05/11/17 12:18	05/08/17	
Chromium	6020A	**8.79**		mg/Kg	0.23	5	05/11/17 10:29	05/08/17	
Cobalt	6020A	**4.19**		mg/Kg	0.023	5	05/11/17 10:29	05/08/17	
Copper	6020A	**40.7**		mg/Kg	0.12	5	05/11/17 10:29	05/08/17	
Iron	6010C	**14300**		mg/Kg	4.7	2	05/11/17 12:18	05/08/17	
Lead	6020A	**107**		mg/Kg	0.058	5	05/11/17 10:29	05/08/17	
Magnesium	6010C	**4770**		mg/Kg	2.3	2	05/11/17 12:18	05/08/17	
Manganese	6010C	**180**		mg/Kg	0.23	2	05/11/17 12:18	05/08/17	
Mercury	7471B	**0.091**		mg/Kg	0.017	1	05/11/17 13:00	05/09/17	
Nickel	6020A	**4.51**		mg/Kg	0.23	5	05/11/17 10:29	05/08/17	
Potassium	6010C	**3120**		mg/Kg	47	2	05/11/17 12:18	05/08/17	
Selenium	6020A	ND	U	mg/Kg	1.2	5	05/11/17 10:29	05/08/17	
Silver	6020A	**0.154**		mg/Kg	0.023	5	05/11/17 10:29	05/08/17	
Sodium	6010C	**3530**		mg/Kg	47	2	05/11/17 12:18	05/08/17	
Thallium	6020A	**0.152**		mg/Kg	0.023	5	05/11/17 10:29	05/08/17	
Vanadium	6020A	**29.7**		mg/Kg	0.23	5	05/11/17 10:29	05/08/17	
Zinc	6010C	**143**		mg/Kg	1.2	2	05/11/17 12:18	05/08/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/05/17 10:00
Sample Matrix:	Sediment	**Date Received:**	05/08/17 09:40
Sample Name:	SED17-15	**Basis:**	Dry
Lab Code:	K1704542-008		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**8220**		mg/Kg	1.9	2	05/11/17 12:21	05/08/17	
Antimony	6020A	ND	U	mg/Kg	0.048	5	05/11/17 10:33	05/08/17	
Arsenic	6020A	**1.94**		mg/Kg	0.48	5	05/11/17 10:33	05/08/17	
Barium	6010C	**169**		mg/Kg	0.77	2	05/11/17 12:21	05/08/17	
Beryllium	6020A	**0.180**		mg/Kg	0.019	5	05/11/17 10:33	05/08/17	
Cadmium	6020A	**0.254**		mg/Kg	0.019	5	05/11/17 10:33	05/08/17	
Calcium	6010C	**7200**		mg/Kg	3.9	2	05/11/17 12:21	05/08/17	
Chromium	6020A	**11.1**		mg/Kg	0.19	5	05/11/17 10:33	05/08/17	
Cobalt	6020A	**5.17**		mg/Kg	0.019	5	05/11/17 10:33	05/08/17	
Copper	6020A	**24.5**		mg/Kg	0.096	5	05/11/17 10:33	05/08/17	
Iron	6010C	**15100**		mg/Kg	3.9	2	05/11/17 12:21	05/08/17	
Lead	6020A	**66.0**		mg/Kg	0.048	5	05/11/17 10:33	05/08/17	
Magnesium	6010C	**5350**		mg/Kg	1.9	2	05/11/17 12:21	05/08/17	
Manganese	6010C	**198**		mg/Kg	0.19	2	05/11/17 12:21	05/08/17	
Mercury	7471B	**0.048**		mg/Kg	0.020	1	05/11/17 13:02	05/09/17	
Nickel	6020A	**5.85**		mg/Kg	0.19	5	05/11/17 10:33	05/08/17	
Potassium	6010C	**3740**		mg/Kg	39	2	05/11/17 12:21	05/08/17	
Selenium	6020A	ND	U	mg/Kg	0.96	5	05/11/17 10:33	05/08/17	
Silver	6020A	**0.119**		mg/Kg	0.019	5	05/11/17 10:33	05/08/17	
Sodium	6010C	**4190**		mg/Kg	39	2	05/11/17 12:21	05/08/17	
Thallium	6020A	**0.191**		mg/Kg	0.019	5	05/11/17 10:33	05/08/17	
Vanadium	6020A	**35.8**		mg/Kg	0.19	5	05/11/17 10:33	05/08/17	
Zinc	6010C	**105**		mg/Kg	0.96	2	05/11/17 12:21	05/08/17	

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Client: Golder Associates, Inc. **Service Request:** K1704542
Project: Skagway-Sediment 2017/1657231 **Date Collected:** 05/05/17 12:00
Sample Matrix: Sediment **Date Received:** 05/08/17 09:40

Sample Name: SED17-27 **Basis:** Dry
Lab Code: K1704542-009

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**11500**		mg/Kg	2.0	2	05/11/17 12:23	05/08/17	
Antimony	6020A	ND	U	mg/Kg	0.049	5	05/11/17 10:36	05/08/17	
Arsenic	6020A	**1.18**		mg/Kg	0.49	5	05/11/17 10:36	05/08/17	
Barium	6010C	**147**		mg/Kg	0.78	2	05/11/17 12:23	05/08/17	
Beryllium	6020A	**0.126**		mg/Kg	0.020	5	05/11/17 10:36	05/08/17	
Cadmium	6020A	**0.072**		mg/Kg	0.020	5	05/11/17 10:36	05/08/17	
Calcium	6010C	**5740**		mg/Kg	3.9	2	05/11/17 12:23	05/08/17	
Chromium	6020A	**12.0**		mg/Kg	0.20	5	05/11/17 10:36	05/08/17	
Cobalt	6020A	**4.68**		mg/Kg	0.020	5	05/11/17 10:36	05/08/17	
Copper	6020A	**5.66**		mg/Kg	0.098	5	05/11/17 10:36	05/08/17	
Iron	6010C	**13000**		mg/Kg	3.9	2	05/11/17 12:23	05/08/17	
Lead	6020A	**3.13**		mg/Kg	0.049	5	05/11/17 10:36	05/08/17	
Magnesium	6010C	**4560**		mg/Kg	2.0	2	05/11/17 12:23	05/08/17	
Manganese	6010C	**179**		mg/Kg	0.20	2	05/11/17 12:23	05/08/17	
Mercury	7471B	ND	U	mg/Kg	0.018	1	05/11/17 13:03	05/09/17	
Nickel	6020A	**5.12**		mg/Kg	0.20	5	05/11/17 10:36	05/08/17	
Potassium	6010C	**2840**		mg/Kg	39	2	05/11/17 12:23	05/08/17	
Selenium	6020A	ND	U	mg/Kg	0.98	5	05/11/17 10:36	05/08/17	
Silver	6020A	**0.039**		mg/Kg	0.020	5	05/11/17 10:36	05/08/17	
Sodium	6010C	**3580**		mg/Kg	39	2	05/11/17 12:23	05/08/17	
Thallium	6020A	**0.161**		mg/Kg	0.020	5	05/11/17 10:36	05/08/17	
Vanadium	6020A	**28.2**		mg/Kg	0.20	5	05/11/17 10:36	05/08/17	
Zinc	6010C	**35.9**		mg/Kg	0.98	2	05/11/17 12:23	05/08/17	

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ1705625-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	ND U	mg/Kg	2	2	05/11/17 11:43	05/08/17	
Antimony	6020A	ND U	mg/Kg	0.05	5	05/11/17 09:14	05/08/17	
Arsenic	6020A	ND U	mg/Kg	0.5	5	05/11/17 09:14	05/08/17	
Barium	6010C	ND U	mg/Kg	0.8	2	05/11/17 11:43	05/08/17	
Beryllium	6020A	ND U	mg/Kg	0.020	5	05/11/17 09:14	05/08/17	
Cadmium	6020A	ND U	mg/Kg	0.020	5	05/11/17 09:14	05/08/17	
Calcium	6010C	ND U	mg/Kg	4	2	05/11/17 11:43	05/08/17	
Chromium	6020A	ND U	mg/Kg	0.20	5	05/11/17 09:14	05/08/17	
Cobalt	6020A	ND U	mg/Kg	0.020	5	05/11/17 09:14	05/08/17	
Copper	6020A	ND U	mg/Kg	0.10	5	05/11/17 09:14	05/08/17	
Iron	6010C	ND U	mg/Kg	4	2	05/11/17 11:43	05/08/17	
Lead	6020A	ND U	mg/Kg	0.05	5	05/11/17 09:14	05/08/17	
Magnesium	6010C	ND U	mg/Kg	2	2	05/11/17 11:43	05/08/17	
Manganese	6010C	ND U	mg/Kg	0.2	2	05/11/17 11:43	05/08/17	
Nickel	6020A	ND U	mg/Kg	0.20	5	05/11/17 09:14	05/08/17	
Potassium	6010C	ND U	mg/Kg	40	2	05/11/17 11:43	05/08/17	
Selenium	6020A	ND U	mg/Kg	1.0	5	05/11/17 09:14	05/08/17	
Silver	6020A	ND U	mg/Kg	0.020	5	05/11/17 09:14	05/08/17	
Sodium	6010C	ND U	mg/Kg	40	2	05/11/17 11:43	05/08/17	
Thallium	6020A	ND U	mg/Kg	0.020	5	05/11/17 09:14	05/08/17	
Vanadium	6020A	ND U	mg/Kg	0.20	5	05/11/17 09:14	05/08/17	
Zinc	6010C	ND U	mg/Kg	1.0	2	05/11/17 11:43	05/08/17	

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ1705630-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Mercury	7471B	ND U	mg/Kg	0.02	1	05/11/17 12:33	05/09/17	

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Sediment	**Date Received:**	05/08/17
		Date Analyzed:	05/11/17

Replicate Sample Summary
Total Metals

Sample Name:	SED17-07	**Units:**	mg/Kg
Lab Code:	K1704542-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1705625-03 Result	Average	RPD	RPD Limit
Aluminum	6010C	2.3	9090	9330	9210	3	20
Antimony	6020A	0.057	ND U	ND U	ND	-	20
Arsenic	6020A	0.57	1.82	1.91	1.87	5	20
Barium	6010C	0.91	179	179	179	<1	20
Beryllium	6020A	0.023	0.161	0.168	0.165	4	20
Cadmium	6020A	0.023	0.290	0.302	0.296	4	20
Calcium	6010C	4.5	3410	3620	3520	6	20
Chromium	6020A	0.23	9.05	11.0	10.0	19	20
Cobalt	6020A	0.023	4.40	5.10	4.75	15	20
Copper	6020A	0.11	33.0	59.4	46.2	57 *	20
Iron	6010C	4.5	16800	18400	17600	9	20
Lead	6020A	0.057	172	178	175	4	20
Magnesium	6010C	2.3	5850	6120	5990	5	20
Manganese	6010C	0.23	227	244	236	7	20
Nickel	6020A	0.23	4.55	5.94	5.25	27 *	20
Potassium	6010C	45	4100	3910	4010	5	20
Selenium	6020A	1.1	ND U	ND U	ND	-	20
Silver	6020A	0.023	0.258	0.282	0.270	9	20
Sodium	6010C	45	3900	3590	3750	8	20
Thallium	6020A	0.023	0.179	0.186	0.183	4	20
Vanadium	6020A	0.23	31.0	34.5	32.8	11	20
Zinc	6010C	1.1	214	219	217	3	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Sediment	**Date Received:**	05/08/17
		Date Analyzed:	05/11/17

Replicate Sample Summary
Total Metals

Sample Name:	SED17-07	**Units:**	mg/Kg
Lab Code:	K1704542-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1705630-03 Result	Average	RPD	RPD Limit
Mercury	7471B	0.021	0.179	0.160	0.170	11	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704542
Date Collected: 05/04/17
Date Received: 05/08/17
Date Analyzed: 5/11/17

Matrix Spike Summary
Total Metals

Sample Name: SED17-07
Lab Code: K1704542-001

Units: mg/Kg
Basis: Dry

Matrix Spike
KQ1705625-04

Analyte Name	Method	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6010C	9090	10000	443	213 #	75-125
Antimony	6020A	ND U	40.1	111	36 N	75-125
Arsenic	6020A	1.82	114	111	101	75-125
Barium	6010C	179	463	222	128 N	75-125
Beryllium	6020A	0.161	10.8	11.1	96	75-125
Cadmium	6020A	0.290	12.0	11.1	106	75-125
Calcium	6010C	3410	4630	1110	110	75-125
Chromium	6020A	9.05	55.9	44.3	106	75-125
Cobalt	6020A	4.40	117	111	102	75-125
Copper	6020A	33.0	101	55.4	122	75-125
Iron	6010C	16800	19000	222	984 #	75-125
Lead	6020A	172	313	111	127 N	75-125
Magnesium	6010C	5850	7270	1110	129 #	75-125
Manganese	6010C	227	357	111	117	75-125
Nickel	6020A	4.55	116	111	100	75-125
Potassium	6010C	4100	5170	1110	96	75-125
Selenium	6020A	ND U	111	111	100	75-125
Silver	6020A	0.258	11.7	11.1	103	75-125
Sodium	6010C	3900	4880	1110	88	75-125
Thallium	6020A	0.179	22.0	22.2	98	75-125
Vanadium	6020A	31.0	150	111	108	75-125
Zinc	6010C	214	324	111	100	75-125

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Sediment	**Date Received:**	05/08/17
		Date Analyzed:	05/11/17
		Date Extracted:	05/9/17

Matrix Spike Summary
Total Metals

Sample Name:	SED17-07	**Units:**	mg/Kg
Lab Code:	K1704542-001	**Basis:**	Dry
Analysis Method:	7471B		
Prep Method:	Method		

Matrix Spike
KQ1705630-04

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Mercury	0.179	0.732	0.587	94	80-120

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/11/17
Sample Matrix:	Sediment		

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1705625-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6010C	7980	7930	101	39-161
Barium	6010C	308	308	100	74-126
Calcium	6010C	6480	6610	98	74-126
Iron	6010C	12800	14400	89	36-164
Magnesium	6010C	2760	2640	104	64-136
Manganese	6010C	423	410	103	76-124
Potassium	6010C	2610	2550	102	61-139
Sodium	6010C	3050	2480	123	65-173
Zinc	6010C	192	191	100	70-130

Client: Golder Associates, Inc. **Service Request:** K1704542
Project: Skagway-Sediment 2017/1657231 **Date Analyzed:** 05/11/17
Sample Matrix: Sediment

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1705625-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Antimony	6020A	64.5	105	61	20-254
Arsenic	6020A	101	98.5	103	69-145
Beryllium	6020A	65.9	66.0	100	74-126
Cadmium	6020A	168	146	115	73-127
Chromium	6020A	189	182	104	71-130
Cobalt	6020A	180	162	111	74-125
Copper	6020A	111	106	104	75-125
Lead	6020A	134	130	103	72-127
Nickel	6020A	169	149	113	73-127
Selenium	6020A	170	154	111	68-132
Silver	6020A	43.8	40.9	107	66-134
Thallium	6020A	209	175	120	69-131
Vanadium	6020A	100	96.7	104	65-135

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/11/17
Sample Matrix:	Sediment		

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1705630-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Mercury	7471B	6.92	7.10	98	51-149

Polynuclear Aromatic Hydrocarbons

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-07	**Units:**	ug/Kg
Lab Code:	K1704542-001	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.9	1	05/12/17	05/15/17	KWG1703871	
2-Methylnaphthalene	ND	U	5.9	1	05/12/17	05/15/17	KWG1703871	
Acenaphthylene	**8.3**		5.9	1	05/12/17	05/15/17	KWG1703871	
Acenaphthene	ND	U	5.9	1	05/12/17	05/15/17	KWG1703871	
Dibenzofuran	ND	U	5.9	1	05/12/17	05/15/17	KWG1703871	
Fluorene	**6.3**		5.9	1	05/12/17	05/15/17	KWG1703871	
Phenanthrene	**35**		5.9	1	05/12/17	05/15/17	KWG1703871	
Anthracene	**22**		5.9	1	05/12/17	05/15/17	KWG1703871	
Fluoranthene	**60**		5.9	1	05/12/17	05/15/17	KWG1703871	*
Pyrene	**87**		5.9	1	05/12/17	05/15/17	KWG1703871	
Benz(a)anthracene	**45**		5.9	1	05/12/17	05/15/17	KWG1703871	
Chrysene	**92**		5.9	1	05/12/17	05/15/17	KWG1703871	
Benzo(b)fluoranthene†	**84**		5.9	1	05/12/17	05/15/17	KWG1703871	
Benzo(k)fluoranthene	**32**		5.9	1	05/12/17	05/15/17	KWG1703871	
Benzo(a)pyrene	**45**		5.9	1	05/12/17	05/15/17	KWG1703871	
Indeno(1,2,3-cd)pyrene	**21**		5.9	1	05/12/17	05/15/17	KWG1703871	
Dibenz(a,h)anthracene	ND	U	5.9	1	05/12/17	05/15/17	KWG1703871	
Benzo(g,h,i)perylene	**17**		5.9	1	05/12/17	05/15/17	KWG1703871	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	71	38-104	05/15/17	Acceptable
Fluoranthene-d10	89	39-109	05/15/17	Acceptable
Terphenyl-d14	82	38-113	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-12	**Units:**	ug/Kg
Lab Code:	K1704542-002	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.4	1	05/12/17	05/15/17	KWG1703871	
2-Methylnaphthalene	ND	U	6.4	1	05/12/17	05/15/17	KWG1703871	
Acenaphthylene	**21**		6.4	1	05/12/17	05/15/17	KWG1703871	
Acenaphthene	ND	U	6.4	1	05/12/17	05/15/17	KWG1703871	
Dibenzofuran	ND	U	6.4	1	05/12/17	05/15/17	KWG1703871	
Fluorene	**13**		6.4	1	05/12/17	05/15/17	KWG1703871	
Phenanthrene	**95**		6.4	1	05/12/17	05/15/17	KWG1703871	
Anthracene	**56**		6.4	1	05/12/17	05/15/17	KWG1703871	
Fluoranthene	**370**		6.4	1	05/12/17	05/15/17	KWG1703871	*
Pyrene	**330**		6.4	1	05/12/17	05/15/17	KWG1703871	
Benz(a)anthracene	**220**		6.4	1	05/12/17	05/15/17	KWG1703871	
Chrysene	**280**		6.4	1	05/12/17	05/15/17	KWG1703871	
Benzo(b)fluoranthene†	**270**		6.4	1	05/12/17	05/15/17	KWG1703871	
Benzo(k)fluoranthene	**97**		6.4	1	05/12/17	05/15/17	KWG1703871	
Benzo(a)pyrene	**130**		6.4	1	05/12/17	05/15/17	KWG1703871	
Indeno(1,2,3-cd)pyrene	**47**		6.4	1	05/12/17	05/15/17	KWG1703871	
Dibenz(a,h)anthracene	**12**		6.4	1	05/12/17	05/15/17	KWG1703871	
Benzo(g,h,i)perylene	**39**		6.4	1	05/12/17	05/15/17	KWG1703871	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	64	38-104	05/15/17	Acceptable
Fluoranthene-d10	83	39-109	05/15/17	Acceptable
Terphenyl-d14	80	38-113	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	DUP-3	**Units:**	ug/Kg
Lab Code:	K1704542-003	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**460**		6.3	1	05/12/17	05/15/17	KWG1703871	
2-Methylnaphthalene	**220**		6.3	1	05/12/17	05/15/17	KWG1703871	
Acenaphthylene	**110**		6.3	1	05/12/17	05/15/17	KWG1703871	
Acenaphthene	**770**		6.3	1	05/12/17	05/15/17	KWG1703871	
Dibenzofuran	**710**		6.3	1	05/12/17	05/15/17	KWG1703871	
Fluorene	**1200**		6.3	1	05/12/17	05/15/17	KWG1703871	
Phenanthrene	**7000**	D	32	5	05/12/17	05/16/17	KWG1703871	
Anthracene	**1400**		6.3	1	05/12/17	05/15/17	KWG1703871	
Fluoranthene	**8900**	D	32	5	05/12/17	05/16/17	KWG1703871	*
Pyrene	**5800**	D	32	5	05/12/17	05/16/17	KWG1703871	
Benz(a)anthracene	**3400**	D	32	5	05/12/17	05/16/17	KWG1703871	
Chrysene	**3300**	D	32	5	05/12/17	05/16/17	KWG1703871	
Benzo(b)fluoranthene†	**3600**	D	32	5	05/12/17	05/16/17	KWG1703871	
Benzo(k)fluoranthene	**1100**		6.3	1	05/12/17	05/15/17	KWG1703871	
Benzo(a)pyrene	**2400**		6.3	1	05/12/17	05/15/17	KWG1703871	
Indeno(1,2,3-cd)pyrene	**1300**		6.3	1	05/12/17	05/15/17	KWG1703871	
Dibenz(a,h)anthracene	**340**		6.3	1	05/12/17	05/15/17	KWG1703871	
Benzo(g,h,i)perylene	**1200**		6.3	1	05/12/17	05/15/17	KWG1703871	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	71	38-104	05/15/17	Acceptable
Fluoranthene-d10	87	39-109	05/15/17	Acceptable
Terphenyl-d14	88	38-113	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-01	**Units:**	ug/Kg
Lab Code:	K1704542-004	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.8	1	05/12/17	05/15/17	KWG1703871	
2-Methylnaphthalene	ND	U	6.8	1	05/12/17	05/15/17	KWG1703871	
Acenaphthylene	ND	U	6.8	1	05/12/17	05/15/17	KWG1703871	
Acenaphthene	ND	U	6.8	1	05/12/17	05/15/17	KWG1703871	
Dibenzofuran	ND	U	6.8	1	05/12/17	05/15/17	KWG1703871	
Fluorene	ND	U	6.8	1	05/12/17	05/15/17	KWG1703871	
Phenanthrene	**14**		6.8	1	05/12/17	05/15/17	KWG1703871	
Anthracene	**8.7**		6.8	1	05/12/17	05/15/17	KWG1703871	
Fluoranthene	**33**		6.8	1	05/12/17	05/15/17	KWG1703871	*
Pyrene	**72**		6.8	1	05/12/17	05/15/17	KWG1703871	
Benz(a)anthracene	**20**		6.8	1	05/12/17	05/15/17	KWG1703871	
Chrysene	**36**		6.8	1	05/12/17	05/15/17	KWG1703871	
Benzo(b)fluoranthene†	**57**		6.8	1	05/12/17	05/15/17	KWG1703871	
Benzo(k)fluoranthene	**19**		6.8	1	05/12/17	05/15/17	KWG1703871	
Benzo(a)pyrene	**27**		6.8	1	05/12/17	05/15/17	KWG1703871	
Indeno(1,2,3-cd)pyrene	**13**		6.8	1	05/12/17	05/15/17	KWG1703871	
Dibenz(a,h)anthracene	ND	U	6.8	1	05/12/17	05/15/17	KWG1703871	
Benzo(g,h,i)perylene	**9.7**		6.8	1	05/12/17	05/15/17	KWG1703871	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	66	38-104	05/15/17	Acceptable
Fluoranthene-d10	81	39-109	05/15/17	Acceptable
Terphenyl-d14	77	38-113	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-03	**Units:**	ug/Kg
Lab Code:	K1704542-005	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
2-Methylnaphthalene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Acenaphthylene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Acenaphthene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Dibenzofuran	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Fluorene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Phenanthrene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Anthracene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Fluoranthene	**7.6**		6.2	1	05/12/17	05/15/17	KWG1703871	*
Pyrene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Benz(a)anthracene	**8.4**		6.2	1	05/12/17	05/15/17	KWG1703871	
Chrysene	**7.5**		6.2	1	05/12/17	05/15/17	KWG1703871	
Benzo(b)fluoranthene†	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Benzo(k)fluoranthene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Benzo(a)pyrene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Indeno(1,2,3-cd)pyrene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Dibenz(a,h)anthracene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Benzo(g,h,i)perylene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	65	38-104	05/15/17	Acceptable
Fluoranthene-d10	80	39-109	05/15/17	Acceptable
Terphenyl-d14	75	38-113	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-29	**Units:**	ug/Kg
Lab Code:	K1704542-006	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	10	1	05/12/17	05/15/17	KWG1703871	
2-Methylnaphthalene	ND	U	10	1	05/12/17	05/15/17	KWG1703871	
Acenaphthylene	ND	U	10	1	05/12/17	05/15/17	KWG1703871	
Acenaphthene	ND	U	10	1	05/12/17	05/15/17	KWG1703871	
Dibenzofuran	ND	U	10	1	05/12/17	05/15/17	KWG1703871	
Fluorene	ND	U	10	1	05/12/17	05/15/17	KWG1703871	
Phenanthrene	ND	U	10	1	05/12/17	05/15/17	KWG1703871	
Anthracene	ND	U	10	1	05/12/17	05/15/17	KWG1703871	
Fluoranthene	**21**		10	1	05/12/17	05/15/17	KWG1703871	*
Pyrene	**22**		10	1	05/12/17	05/15/17	KWG1703871	
Benz(a)anthracene	**23**		10	1	05/12/17	05/15/17	KWG1703871	
Chrysene	**12**		10	1	05/12/17	05/15/17	KWG1703871	
Benzo(b)fluoranthene†	**25**		10	1	05/12/17	05/15/17	KWG1703871	
Benzo(k)fluoranthene	ND	U	10	1	05/12/17	05/15/17	KWG1703871	
Benzo(a)pyrene	**11**		10	1	05/12/17	05/15/17	KWG1703871	
Indeno(1,2,3-cd)pyrene	ND	U	10	1	05/12/17	05/15/17	KWG1703871	
Dibenz(a,h)anthracene	ND	U	10	1	05/12/17	05/15/17	KWG1703871	
Benzo(g,h,i)perylene	ND	U	10	1	05/12/17	05/15/17	KWG1703871	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	61	38-104	05/15/17	Acceptable
Fluoranthene-d10	47	39-109	05/15/17	Acceptable
Terphenyl-d14	62	38-113	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/05/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-10	**Units:**	ug/Kg
Lab Code:	K1704542-007	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.4	1	05/12/17	05/15/17	KWG1703871	
2-Methylnaphthalene	ND	U	6.4	1	05/12/17	05/15/17	KWG1703871	
Acenaphthylene	**9.3**	X	6.4	1	05/12/17	05/15/17	KWG1703871	
Acenaphthene	ND	U	6.4	1	05/12/17	05/15/17	KWG1703871	
Dibenzofuran	ND	U	6.4	1	05/12/17	05/15/17	KWG1703871	
Fluorene	**16**		6.4	1	05/12/17	05/15/17	KWG1703871	
Phenanthrene	**91**		6.4	1	05/12/17	05/15/17	KWG1703871	
Anthracene	**36**		6.4	1	05/12/17	05/15/17	KWG1703871	
Fluoranthene	**360**		6.4	1	05/12/17	05/15/17	KWG1703871	*
Pyrene	**230**		6.4	1	05/12/17	05/15/17	KWG1703871	
Benz(a)anthracene	**120**		6.4	1	05/12/17	05/15/17	KWG1703871	
Chrysene	**110**		6.4	1	05/12/17	05/15/17	KWG1703871	
Benzo(b)fluoranthene†	**120**		6.4	1	05/12/17	05/15/17	KWG1703871	
Benzo(k)fluoranthene	**43**		6.4	1	05/12/17	05/15/17	KWG1703871	
Benzo(a)pyrene	**60**		6.4	1	05/12/17	05/15/17	KWG1703871	
Indeno(1,2,3-cd)pyrene	**23**		6.4	1	05/12/17	05/15/17	KWG1703871	
Dibenz(a,h)anthracene	ND	U	6.4	1	05/12/17	05/15/17	KWG1703871	
Benzo(g,h,i)perylene	**17**		6.4	1	05/12/17	05/15/17	KWG1703871	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	75	38-104	05/15/17	Acceptable
Fluoranthene-d10	85	39-109	05/15/17	Acceptable
Terphenyl-d14	85	38-113	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/05/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-15	**Units:**	ug/Kg
Lab Code:	K1704542-008	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.3	1	05/12/17	05/15/17	KWG1703871	
2-Methylnaphthalene	ND	U	6.3	1	05/12/17	05/15/17	KWG1703871	
Acenaphthylene	**7.6**	X	6.3	1	05/12/17	05/15/17	KWG1703871	
Acenaphthene	ND	U	6.3	1	05/12/17	05/15/17	KWG1703871	
Dibenzofuran	ND	U	6.3	1	05/12/17	05/15/17	KWG1703871	
Fluorene	**8.8**		6.3	1	05/12/17	05/15/17	KWG1703871	
Phenanthrene	**75**		6.3	1	05/12/17	05/15/17	KWG1703871	
Anthracene	**18**		6.3	1	05/12/17	05/15/17	KWG1703871	
Fluoranthene	**260**		6.3	1	05/12/17	05/15/17	KWG1703871	*
Pyrene	**170**		6.3	1	05/12/17	05/15/17	KWG1703871	
Benz(a)anthracene	**79**		6.3	1	05/12/17	05/15/17	KWG1703871	
Chrysene	**61**		6.3	1	05/12/17	05/15/17	KWG1703871	
Benzo(b)fluoranthene†	**69**		6.3	1	05/12/17	05/15/17	KWG1703871	
Benzo(k)fluoranthene	**26**		6.3	1	05/12/17	05/15/17	KWG1703871	
Benzo(a)pyrene	**34**		6.3	1	05/12/17	05/15/17	KWG1703871	
Indeno(1,2,3-cd)pyrene	**13**		6.3	1	05/12/17	05/15/17	KWG1703871	
Dibenz(a,h)anthracene	ND	U	6.3	1	05/12/17	05/15/17	KWG1703871	
Benzo(g,h,i)perylene	**9.4**		6.3	1	05/12/17	05/15/17	KWG1703871	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	68	38-104	05/15/17	Acceptable
Fluoranthene-d10	79	39-109	05/15/17	Acceptable
Terphenyl-d14	80	38-113	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/05/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	SED17-27	**Units:**	ug/Kg
Lab Code:	K1704542-009	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
2-Methylnaphthalene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Acenaphthylene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Acenaphthene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Dibenzofuran	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Fluorene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Phenanthrene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Anthracene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Fluoranthene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Pyrene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Benz(a)anthracene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Chrysene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Benzo(b)fluoranthene†	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Benzo(k)fluoranthene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Benzo(a)pyrene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Indeno(1,2,3-cd)pyrene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Dibenz(a,h)anthracene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	
Benzo(g,h,i)perylene	ND	U	6.2	1	05/12/17	05/15/17	KWG1703871	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	74	38-104	05/15/17	Acceptable
Fluoranthene-d10	98	39-109	05/15/17	Acceptable
Terphenyl-d14	87	38-113	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Polynuclear Aromatic Hydrocarbons

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG1703871-5	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
2-Methylnaphthalene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Acenaphthylene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Acenaphthene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Dibenzofuran	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Fluorene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Phenanthrene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Anthracene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Fluoranthene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Pyrene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Benz(a)anthracene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Chrysene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Benzo(b)fluoranthene†	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Benzo(k)fluoranthene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Benzo(a)pyrene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Indeno(1,2,3-cd)pyrene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Dibenz(a,h)anthracene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	
Benzo(g,h,i)perylene	ND	U	4.8	1	05/12/17	05/15/17	KWG1703871	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	72	38-104	05/15/17	Acceptable
Fluoranthene-d10	96	39-109	05/15/17	Acceptable
Terphenyl-d14	88	38-113	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

QA/QC Report

Client: Golder Associates, Inc. **Service Request:** K1704542
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Surrogate Recovery Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3546 **Units:** Percent
Analysis Method: 8270D SIM **Level:** Low

Sample Name	Lab Code	Sur1	Sur2	Sur3
SED17-07	K1704542-001	71	89	82
SED17-12	K1704542-002	64	83	80
DUP-3	K1704542-003	71	87	88
SED17-01	K1704542-004	66	81	77
SED17-03	K1704542-005	65	80	75
SED17-29	K1704542-006	61	47	62
SED17-10	K1704542-007	75	85	85
SED17-15	K1704542-008	68	79	80
SED17-27	K1704542-009	74	98	87
Batch QC	K1704596-001	79	102	84
Method Blank	KWG1703871-5	72	96	88
Batch QCMS	KWG1703871-1	70	94	81
Batch QCDMS	KWG1703871-2	62	81	69
Lab Control Sample	KWG1703871-3	62	81	73
Duplicate Lab Control Sample	KWG1703871-4	60	77	70

Surrogate Recovery Control Limits (%)

Sur1	=	Fluorene-d10	38-104
Sur2	=	Fluoranthene-d10	39-109
Sur3	=	Terphenyl-d14	38-113

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Extracted:**	05/12/2017
Sample Matrix:	Soil	**Date Analyzed:**	05/15/2017

Matrix Spike/Duplicate Matrix Spike Summary
Polynuclear Aromatic Hydrocarbons

Sample Name:	Batch QC	**Units:**	ug/Kg
Lab Code:	K1704596-001	**Basis:**	Dry
Extraction Method:	EPA 3546	**Level:**	Low
Analysis Method:	8270D SIM	**Extraction Lot:**	KWG1703871

		Batch QCMS KWG1703871-1 **Matrix Spike**			Batch QCDMS KWG1703871-2 **Duplicate Matrix Spike**					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	ND	376	540	69	331	544	61	29-88	13	40
2-Methylnaphthalene	ND	396	540	73	354	544	65	28-98	11	40
Acenaphthylene	ND	419	540	77	374	544	69	32-97	11	40
Acenaphthene	ND	394	540	73	350	544	64	30-101	12	40
Dibenzofuran	ND	519	540	96	366	544	67	28-105	35	40
Fluorene	ND	408	540	76	363	544	67	23-116	12	40
Phenanthrene	6.0	427	540	78	373	544	67	10-128	14	40
Anthracene	ND	425	540	79	372	544	68	27-116	13	40
Fluoranthene	12	504	540	91	437	544	78	10-138	14	40
Pyrene	7.0	440	540	80	376	544	68	16-134	16	40
Benz(a)anthracene	ND	470	540	87	407	544	75	27-127	14	40
Chrysene	ND	442	540	82	383	544	70	25-132	14	40
Benzo(b)fluoranthene	ND	452	540	84	398	544	73	21-130	13	40
Benzo(k)fluoranthene	ND	454	540	84	397	544	73	22-126	14	40
Benzo(a)pyrene	ND	434	540	80	379	544	70	25-129	13	40
Indeno(1,2,3-cd)pyrene	ND	435	540	80	377	544	69	17-138	14	40
Dibenz(a,h)anthracene	ND	383	540	71	333	544	61	32-116	14	40
Benzo(g,h,i)perylene	ND	421	540	78	362	544	66	17-130	15	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704542
Project:	Skagway-Sediment 2017/1657231	**Date Extracted:**	05/12/2017
Sample Matrix:	Soil	**Date Analyzed:**	05/15/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method:	EPA 3546	**Units:**	ug/Kg
Analysis Method:	8270D SIM	**Basis:**	Dry
		Level:	Low
		Extraction Lot:	KWG1703871

	Lab Control Sample KWG1703871-3 **Lab Control Spike**			Duplicate Lab Control Sample KWG1703871-4 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	314	500	63	340	500	68	42-88	8	40
2-Methylnaphthalene	334	500	67	362	500	72	43-92	8	40
Acenaphthylene	358	500	72	381	500	76	44-93	6	40
Acenaphthene	337	500	67	359	500	72	44-95	6	40
Dibenzofuran	351	500	70	452	500	90	44-96	25	40
Fluorene	345	500	69	371	500	74	45-98	7	40
Phenanthrene	346	500	69	370	500	74	41-99	7	40
Anthracene	356	500	71	372	500	74	46-100	4	40
Fluoranthene	415	500	83	435	500	87	49-102	5	40
Pyrene	365	500	73	386	500	77	48-104	5	40
Benz(a)anthracene	386	500	77	412	500	82	52-105	6	40
Chrysene	370	500	74	395	500	79	51-110	6	40
Benzo(b)fluoranthene	399	500	80	424	500	85	52-114	6	40
Benzo(k)fluoranthene	405	500	81	429	500	86	52-112	6	40
Benzo(a)pyrene	378	500	76	402	500	80	52-111	6	40
Indeno(1,2,3-cd)pyrene	385	500	77	410	500	82	44-117	6	40
Dibenz(a,h)anthracene	350	500	70	370	500	74	44-110	5	40
Benzo(g,h,i)perylene	363	500	73	383	500	77	45-107	5	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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June 01, 2017

Analytical Report for Service Request No: K1704543

Tamra Reynolds
Golder Associates Ltd.
Suite 201C, 170 Titanium Way
Whitehorse, YT Y1A0G1

RE: Skagway-Sediment 2017 / 1657231

Dear Tamra,

Enclosed are the results of the sample(s) submitted to our laboratory May 08, 2017
For your reference, these analyses have been assigned our service request number **K1704543.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3364. You may also contact me via email at howard.holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Howard Holmes
Project Manager

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Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

* * The result is an outlier. See case narrative.
* \# The control limit criteria is not applicable. See case narrative.
* B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
* E The result is an estimate amount because the value exceeded the instrument calibration range.
* J The result is an estimated value.
* U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
* i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
* X See case narrative.
* Q See case narrative. One or more quality control criteria was outside the limits.
* H The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

* \# The control limit criteria is not applicable. See case narrative.
* J The result is an estimated value.
* E The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
* M The duplicate injection precision was not met.
* N The Matrix Spike sample recovery is not within control limits. See case narrative.
* S The reported value was determined by the Method of Standard Additions (MSA).
* U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
* W The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
* i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
* X See case narrative.
* \+ The correlation coefficient for the MSA is less than 0.995.
* Q See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

* * The result is an outlier. See case narrative.
* \# The control limit criteria is not applicable. See case narrative.
* A A tentatively identified compound, a suspected aldol-condensation product.
* B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
* C The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
* D The reported result is from a dilution.
* E The result is an estimated value.
* J The result is an estimated value.
* N The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
* P The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
* U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
* i The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
* X See case narrative.
* Q See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

* F The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
* L The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
* H The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
* O The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
* Y The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
* Z The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEH	http://dec.alaska.gov/eh/lab/cs/csapproval.htm	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	http://health.hawaii.gov/	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/page/la-lab-accreditation	03016
Maine DHS	http://www.maine.gov/dhhs/	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/enforcement/oqa.html	WA005
New York - DOH	https://www.wadsworth.org/regulatory/elap	12060
North Carolina DEQ	https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/EnvironmentalLabCertification/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water-	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS Environmental—Kelso Laboratory
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ALS ENVIRONMENTAL

Client:	Golder Associates, Inc.	**Service Request No.:**	K1704543
Project:	Skagway - Sediment 2017/ 1657231	**Date Received:**	05/08/17
Sample Matrix:	Sediment		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt

Nine sediment samples were received for analysis at ALS Environmental on 05/08/17. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry Parameters

No anomalies associated with the analysis of these samples were observed.

Total Metals

No anomalies associated with the analysis of these samples were observed.

Diesel and Residual Range Organics by Method AK102/ AK103

No anomalies associated with the analysis of these samples were observed.

Approved by____

Chain of Custody

ALS Environmental—Kelso Laboratory
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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 - 594997 K1704543

Page 1 of 4

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates LTD
Contact:	Tamra Reynolds
Phone:	1-867-334-4468
	Company address below will appear on the final report
Street:	170 - 201 C Titanium Way
City/Province:	Whitehorse, Yukon
Postal Code:	Y1A 0G1
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: TREYNOLDS@golder.com

Email 2: PADDY_MCMANUS@golder.com

Email 3: VMERCER@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: same as report

Email 2:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☑ ; 3 day [P3] ☐ ; 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ ; Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: 41037

Job #: 1657231

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#

Major/Minor Code: | Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Parker | Sampler: PM / JM

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals	PAHs	Grainsize (GS)	Total Organic Carbon (TOC)	DRO	AVS/SEM	Number of Containers
	SED17-07	04-MAY-17	10:00	Sediment	X	X	X	X			4
	SED17-12	↓	12:00	↓	↓	↓	↓	↓			↓
	DUP-3	↓	13:00	↓	↓	↓	↓	↓			↓
	SED17-01	↓	14:40	↓	↓	↓	↓	↓			↓
	SED17-03	↓	16:00	↓	↓	↓	↓	↓			↓
	SED17-29	↓	18:00	↓	↓	↓	↓	↓			↓
	SED17-10	05-MAY-17	9:00	↓	↓	↓	↓	↓			↓
	SED17-15	↓	10:00	↓	↓	↓	↓	↓			↓
	SED17-27	↓	12:00	↓	↓	↓	↓	↓			↓
	Travel Blank	04-MAY-17	18:00	Water	↓	↓					5
	FB-1	↓	18:00	↓	↓	↓					↓
	EB-1	↓	18:00	↓	↓	↓					↓

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Please archive unused samples, 5-day turnaround on metals and PAHs, regular turnaround on GS and TOC, wait for directions for DRO and AVS/SEM.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ ; SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ ; Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 05-MAY-17	Time: 15:00	Received by: [signature]	Date: 5/8/17	Time: 0840	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

PC H2

Cooler Receipt and Preservation Form

Client Golder Service Request K17 04543

Received: 5/8/17 Opened: 5/8/17 By: [illegible] Unloaded: 5/8/17 By: [illegible]

1. Samples were received via? *USPS* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* ______ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where? one, front

   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
2.1	2.1	3.4	3.4	0	298			✓
-2.1	-2.2	frozen	→	-0.1	372			

4. Packing material: *Inserts* *Baggies* ~~*Bubble Wrap*~~ *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* boxes
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA Y N

   If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions:

RUSH

7/25/16 *Page* ____ *of* ____

Total Solids

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17 - 05/05/17
Sample Matrix:	Sediment	**Date Received:**	05/8/17
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
SED17-07	K1704543-001	**83.3**	-	1	05/08/17 16:10	
SED17-12	K1704543-002	**76.7**	-	1	05/08/17 16:10	
DUP-3	K1704543-003	**77.0**	-	1	05/08/17 16:10	
SED17-01	K1704543-004	**71.1**	-	1	05/08/17 16:10	
SED17-03	K1704543-005	**79.1**	-	1	05/08/17 16:10	
SED17-29	K1704543-006	**50.1**	-	1	05/08/17 16:10	
SED17-10	K1704543-007	**77.0**	-	1	05/08/17 16:10	
SED17-15	K1704543-008	**78.8**	-	1	05/08/17 16:10	
SED17-27	K1704543-009	**77.5**	-	1	05/08/17 16:10	

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	NA

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Batch QC	K1704524-001DUP	-	86.4	82.7	84.6	4	20	05/08/17

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 5/9/2017 9:21:27 AM Superset Reference:17-0000421029 rev 00

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Batch QC	K1704539-001DUP	-	63.4	62.6	63.0	1	20	05/08/17
Batch QC	K1704542-007DUP	-	77.9	76.8	77.4	1	20	05/08/17

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

General Chemistry

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17 - 05/05/17
Sample Matrix:	Sediment	**Date Received:**	05/8/17
Analysis Method:	821/R-91-100	**Units:**	uMole/g
Prep Method:	Method	**Basis:**	Dry

Sulfide, Acid-Volatile

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Date Extracted	Q
SED17-07	K1704543-001	**0.090**	0.034	1	05/19/17 00:32	5/18/17	
SED17-12	K1704543-002	**0.125**	0.034	1	05/19/17 00:32	5/18/17	
SED17-01	K1704543-004	**0.148**	0.036	1	05/19/17 00:32	5/18/17	
SED17-03	K1704543-005	**0.48**	0.12	4	05/19/17 00:32	5/18/17	
SED17-29	K1704543-006	**2.7**	1.2	20	05/19/17 00:32	5/18/17	
SED17-10	K1704543-007	**0.121**	0.038	1	05/19/17 00:32	5/18/17	
SED17-15	K1704543-008	**0.207**	0.035	1	05/19/17 00:32	5/18/17	
SED17-27	K1704543-009	**0.057**	0.034	1	05/19/17 00:32	5/18/17	
Method Blank	K1704543-MB	ND U	0.016	1	05/19/17 00:32	5/18/17	

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Sediment	**Date Received:**	05/08/17
		Date Analyzed:	05/19/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	SED17-07	**Units:**	uMole/g
Lab Code:	K1704543-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1704543-001DUP Result	Average	RPD	RPD Limit
Sulfide, Acid-Volatile	821/R-91-100	0.038	0.090	0.072	0.0813	22	45

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Sediment	**Date Received:**	05/08/17
		Date Analyzed:	05/19/17
		Date Extracted:	05/18/17

Duplicate Matrix Spike Summary
Sulfide, Acid-Volatile

Sample Name:	SED17-07	**Units:**	uMole/g
Lab Code:	K1704543-001	**Basis:**	Dry
Analysis Method:	821/R-91-100		
Prep Method:	Method		

		Matrix Spike K1704543-001MS			Duplicate Matrix Spike K1704543-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Sulfide, Acid-Volatile	0.090	23.2	25.8	89	23.5	25.6	91	56-142	1	45

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/19/17
Sample Matrix:	Sediment	**Date Extracted:**	05/18/17

Lab Control Sample Summary
Sulfide, Acid-Volatile

Analysis Method:	821/R-91-100	**Units:**	uMole/g
Prep Method:	Method	**Basis:**	Dry
		Analysis Lot:	546324

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1704543-LCS	0.205	0.221	92	60-115

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/4/2017
Sample Matrix:	Sediment	**Date Received:**	5/8/2017
		Date Analyzed:	5/9/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-07
Lab Code: K1704543-001

Sand Fraction: Weight (Grams)	55.2558
Sand Fraction: Weight Recovered (Grams)	55.3188
Sand Fraction: Percent Recovery	100.11

Weight as received (Grams)	80.043
Percent Solids	83.3
Weight Oven-Dried (Grams)	66.6758

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	26.7093	40.06
Gravel, Fine	2.00 mm	10	5.6831	8.52
Sand, Very Coarse	0.850 mm	20	5.2360	7.85
Sand, Coarse	0.425 mm	40	3.8782	5.82
Sand, Medium	0.250 mm	60	3.3821	5.07
Sand, Fine	0.106 mm	140	7.0624	10.59
Sand, Very Fine	0.075 mm	200	2.7269	4.09
Silt			10.5500	15.82
Clay			3.8400	5.76
		Total	69.0680	103.58

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/4/2017
Sample Matrix:	Sediment	**Date Received:**	5/8/2017
		Date Analyzed:	5/9/2017

Particle Size Determination

ASTM D422M

Sample Name: SED17-12

Lab Code: K1704543-002

Sand Fraction: Weight (Grams)	33.7671
Sand Fraction: Weight Recovered (Grams)	33.7317
Sand Fraction: Percent Recovery	99.90

Weight as received (Grams)	56.253
Percent Solids	76.7
Weight Oven-Dried (Grams)	43.1461

Description	**Sieve Size**	**Sieve Number**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	4.75 mm	4	3.2502	7.53
Gravel, Fine	2.00 mm	10	2.8709	6.65
Sand, Very Coarse	0.850 mm	20	7.5027	17.39
Sand, Coarse	0.425 mm	40	9.0485	20.97
Sand, Medium	0.250 mm	60	5.0143	11.62
Sand, Fine	0.106 mm	140	4.5844	10.63
Sand, Very Fine	0.075 mm	200	1.2244	2.84
Silt			5.7000	13.21
Clay			4.1450	9.61
		Total	43.3404	100.45

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/4/2017
Sample Matrix:	Sediment	**Date Received:**	5/8/2017
		Date Analyzed:	5/9/2017

Particle Size Determination
ASTM D422M

Sample Name: DUP-3
Lab Code: K1704543-003

Sand Fraction: Weight (Grams)	26.6049
Sand Fraction: Weight Recovered (Grams)	26.7185
Sand Fraction: Percent Recovery	100.43

Weight as received (Grams)	42.859
Percent Solids	77.0
Weight Oven-Dried (Grams)	33.0014

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	4.4011	13.34
Gravel, Fine	2.00 mm	10	2.2870	6.93
Sand, Very Coarse	0.850 mm	20	5.4516	16.52
Sand, Coarse	0.425 mm	40	6.6881	20.27
Sand, Medium	0.250 mm	60	3.7556	11.38
Sand, Fine	0.106 mm	140	3.1217	9.46
Sand, Very Fine	0.075 mm	200	0.7804	2.36
Silt			3.7500	11.36
Clay			2.8650	8.68
		Total	33.1005	100.30

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/4/2017
Sample Matrix:	Sediment	**Date Received:**	5/8/2017
		Date Analyzed:	5/9/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-01
Lab Code: K1704543-004

Sand Fraction: Weight (Grams)	9.9158
Sand Fraction: Weight Recovered (Grams)	9.8114
Sand Fraction: Percent Recovery	98.95

Weight as received (Grams)	38.891
Percent Solids	71.1
Weight Oven-Dried (Grams)	27.6515

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.0000	0.00
Gravel, Fine	2.00 mm	10	0.1259	0.46
Sand, Very Coarse	0.850 mm	20	0.2526	0.91
Sand, Coarse	0.425 mm	40	0.7449	2.69
Sand, Medium	0.250 mm	60	1.4785	5.35
Sand, Fine	0.106 mm	140	3.5123	12.70
Sand, Very Fine	0.075 mm	200	2.7619	9.99
Silt			14.8450	53.69
Clay			4.3000	15.55
		Total	28.0211	101.34

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/4/2017
Sample Matrix:	Sediment	**Date Received:**	5/8/2017
		Date Analyzed:	5/9/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-03
Lab Code: K1704543-005

Sand Fraction: Weight (Grams)	56.9258
Sand Fraction: Weight Recovered (Grams)	56.9439
Sand Fraction: Percent Recovery	100.03

Weight as received (Grams)	80.078
Percent Solids	79.1
Weight Oven-Dried (Grams)	63.3417

Description	**Sieve Size**	**Sieve Number**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	4.75 mm	4	3.2384	5.11
Gravel, Fine	2.00 mm	10	4.2563	6.72
Sand, Very Coarse	0.850 mm	20	11.6028	18.32
Sand, Coarse	0.425 mm	40	22.7523	35.92
Sand, Medium	0.250 mm	60	10.2106	16.12
Sand, Fine	0.106 mm	140	3.2537	5.14
Sand, Very Fine	0.075 mm	200	1.3536	2.14
Silt			4.5850	7.24
Clay			2.0750	3.28
		Total	63.3277	99.99

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/4/2017
Sample Matrix:	Sediment	**Date Received:**	5/8/2017
		Date Analyzed:	5/9/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-29
Lab Code: K1704543-006

Sand Fraction: Weight (Grams)	2.9215
Sand Fraction: Weight Recovered (Grams)	2.9306
Sand Fraction: Percent Recovery	100.31

Weight as received (Grams)	38.144
Percent Solids	50.1
Weight Oven-Dried (Grams)	19.1101

Description	**Sieve Size**	**Sieve Number**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	4.75 mm	4	0.0000	0.00
Gravel, Fine	2.00 mm	10	0.3595	1.88
Sand, Very Coarse	0.850 mm	20	0.4284	2.24
Sand, Coarse	0.425 mm	40	0.3034	1.59
Sand, Medium	0.250 mm	60	0.2830	1.48
Sand, Fine	0.106 mm	140	0.7980	4.18
Sand, Very Fine	0.075 mm	200	0.5638	2.95
Silt			13.4850	70.56
Clay			3.4750	18.18
		Total	19.6961	103.06

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/5/2017
Sample Matrix:	Sediment	**Date Received:**	5/8/2017
		Date Analyzed:	5/9/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-10
Lab Code: K1704543-007

Sand Fraction: Weight (Grams)	29.6127
Sand Fraction: Weight Recovered (Grams)	29.5764
Sand Fraction: Percent Recovery	99.88

Weight as received (Grams)	46.692
Percent Solids	77.0
Weight Oven-Dried (Grams)	35.9528

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	0.7251	2.02
Gravel, Fine	2.00 mm	10	0.5202	1.45
Sand, Very Coarse	0.850 mm	20	2.1241	5.91
Sand, Coarse	0.425 mm	40	7.7102	21.45
Sand, Medium	0.250 mm	60	8.9902	25.01
Sand, Fine	0.106 mm	140	7.7395	21.53
Sand, Very Fine	0.075 mm	200	1.5180	4.22
Silt			4.0500	11.26
Clay			2.6800	7.45
		Total	36.0573	100.30

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/5/2017
Sample Matrix:	Sediment	**Date Received:**	5/8/2017
		Date Analyzed:	5/9/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-15
Lab Code: K1704543-008

Sand Fraction: Weight (Grams)	50.8244
Sand Fraction: Weight Recovered (Grams)	50.7432
Sand Fraction: Percent Recovery	99.84

Weight as received (Grams)	78.334
Percent Solids	78.8
Weight Oven-Dried (Grams)	61.7272

Description	**Sieve Size**	**Sieve Number**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	4.75 mm	4	8.0753	13.08
Gravel, Fine	2.00 mm	10	2.4257	3.93
Sand, Very Coarse	0.850 mm	20	6.1139	9.90
Sand, Coarse	0.425 mm	40	13.0416	21.13
Sand, Medium	0.250 mm	60	10.2483	16.60
Sand, Fine	0.106 mm	140	9.0127	14.60
Sand, Very Fine	0.075 mm	200	1.5212	2.46
Silt			6.4050	10.38
Clay			4.4500	7.21
		Total	61.2937	99.29

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/5/2017
Sample Matrix:	Sediment	**Date Received:**	5/8/2017
		Date Analyzed:	5/9/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-27
Lab Code: K1704543-009

Sand Fraction: Weight (Grams)	41.3098
Sand Fraction: Weight Recovered (Grams)	39.3105
Sand Fraction: Percent Recovery	95.16

Weight as received (Grams)	73.062
Percent Solids	77.5
Weight Oven-Dried (Grams)	56.6231

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	2.9522	5.21
Gravel, Fine	2.00 mm	10	3.3763	5.96
Sand, Very Coarse	0.850 mm	20	13.5278	23.89
Sand, Coarse	0.425 mm	40	3.1543	5.57
Sand, Medium	0.250 mm	60	0.4122	0.73
Sand, Fine	0.106 mm	140	3.9210	6.92
Sand, Very Fine	0.075 mm	200	8.1744	14.44
Silt			18.7200	33.06
Clay			0.9900	1.75
		Total	55.2282	97.53

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/4/2017
Sample Matrix:	Sediment	**Date Received:**	5/8/2017
		Date Analyzed:	5/9/2017

Particle Size Determination
ASTM D422M

Sample Name: SED17-07
Lab Code: K1704543-001DUP

Sand Fraction: Weight (Grams)	55.2208
Sand Fraction: Weight Recovered (Grams)	54.8597
Sand Fraction: Percent Recovery	99.35

Weight as received (Grams)	79.107
Percent Solids	83.3
Weight Oven-Dried (Grams)	65.8961

Description	Sieve Size	Sieve Number	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	4.75 mm	4	28.4376	43.16
Gravel, Fine	2.00 mm	10	4.6724	7.09
Sand, Very Coarse	0.850 mm	20	4.5248	6.87
Sand, Coarse	0.425 mm	40	3.8047	5.77
Sand, Medium	0.250 mm	60	3.2582	4.94
Sand, Fine	0.106 mm	140	6.6283	10.06
Sand, Very Fine	0.075 mm	200	2.4929	3.78
Silt			10.4900	15.92
Clay			3.7150	5.64
		Total	68.0239	103.23

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17 - 05/05/17
Sample Matrix:	Sediment	**Date Received:**	05/8/17
Analysis Method:	Walkley-Black	**Units:**	mg/Kg
Prep Method:	None	**Basis:**	Dry

Carbon, Total Organic

Sample Name	Lab Code	Result		MRL	Dil.	Date Analyzed	Q
SED17-07	K1704543-001	ND	U	2400	1	05/17/17 15:00	
SED17-12	K1704543-002	ND	U	2500	1	05/17/17 15:00	
DUP-3	K1704543-003	ND	U	2600	1	05/17/17 15:00	
SED17-01	K1704543-004	ND	U	2800	1	05/17/17 15:00	
SED17-03	K1704543-005	ND	U	2500	1	05/17/17 15:00	
SED17-29	K1704543-006	**24100**		3900	1	05/17/17 15:00	
SED17-10	K1704543-007	**3600**		2600	1	05/17/17 15:00	
SED17-15	K1704543-008	ND	U	2400	1	05/17/17 15:00	
SED17-27	K1704543-009	ND	U	2500	1	05/17/17 15:00	
Method Blank	K1704543-MB	ND	U	2000	1	05/17/17 15:00	

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Sediment	**Date Received:**	05/08/17
		Date Analyzed:	05/17/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	SED17-01	**Units:**	mg/Kg
Lab Code:	K1704543-004	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1704543-004DUP Result	Average	RPD	RPD Limit
Carbon, Total Organic	Walkley-Black	2800	ND U	ND U	NC	NC	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/17/17
Sample Matrix:	Sediment	**Date Extracted:**	NA

Lab Control Sample Summary
Carbon, Total Organic

Analysis Method:	Walkley-Black	**Units:**	mg/Kg
Prep Method:	None	**Basis:**	Dry
		Analysis Lot:	546113

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1704543-LCS	4700	5400	87	85-115

Metals

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704543
Project No.: 1657231
Date Collected: 5/4/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/8/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-07 **Lab Code:** K1704543-001

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.006	1.0	05/18/17	05/24/17	0.006	U	
Arsenic	6010C	0.011	1.0	05/18/17	05/24/17	0.011	U	
Cadmium	6010C	0.0004	1.0	05/18/17	05/24/17	0.0004	U	
Chromium	6010C	0.004	1.0	05/18/17	05/24/17	0.010		
Copper	6010C	0.004	1.0	05/18/17	05/24/17	0.230		
Lead	6010C	0.002	1.0	05/18/17	05/24/17	0.324		
Mercury	7470A	0.00008	4.0	05/18/17	05/26/17	0.00008	U	
Nickel	6010C	0.002	1.0	05/18/17	05/24/17	0.007		
Silver	6010C	0.002	1.0	05/18/17	05/24/17	0.002	U	
Zinc	6010C	0.006	1.0	05/18/17	05/24/17	0.631		

% Solids: 83.3

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704543
Project No.: 1657231
Date Collected: 5/4/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/8/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-12
Lab Code: K1704543-002

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.006	1.0	05/18/17	05/24/17	0.006	U	
Arsenic	6010C	0.011	1.0	05/18/17	05/24/17	0.011	U	
Cadmium	6010C	0.0004	1.0	05/18/17	05/24/17	0.0009		
Chromium	6010C	0.004	1.0	05/18/17	05/24/17	0.012		
Copper	6010C	0.004	1.0	05/18/17	05/24/17	0.407		
Lead	6010C	0.002	1.0	05/18/17	05/24/17	0.543		
Mercury	7470A	0.00009	4.0	05/18/17	05/26/17	0.00009	U	
Nickel	6010C	0.002	1.0	05/18/17	05/24/17	0.013		
Silver	6010C	0.002	1.0	05/18/17	05/24/17	0.002	U	
Zinc	6010C	0.006	1.0	05/18/17	05/24/17	0.907		

% Solids: 76.7

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704543
Project No.: 1657231
Date Collected: 5/4/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/8/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-01
Lab Code: K1704543-004

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.007	1.0	05/18/17	05/24/17	0.007	U	
Arsenic	6010C	0.011	1.0	05/18/17	05/24/17	0.011	U	
Cadmium	6010C	0.0004	1.0	05/18/17	05/24/17	0.0007		
Chromium	6010C	0.004	1.0	05/18/17	05/24/17	0.014		
Copper	6010C	0.004	1.0	05/18/17	05/24/17	0.073		
Lead	6010C	0.002	1.0	05/18/17	05/24/17	0.177		
Mercury	7470A	0.00009	4.0	05/18/17	05/26/17	0.00009	U	
Nickel	6010C	0.002	1.0	05/18/17	05/24/17	0.013		
Silver	6010C	0.002	1.0	05/18/17	05/24/17	0.002	U	
Zinc	6010C	0.007	1.0	05/18/17	05/24/17	0.502		

% Solids: 71.1

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704543
Project No.: 1657231
Date Collected: 5/4/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/8/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-03
Lab Code: K1704543-005

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.006	1.0	05/18/17	05/24/17	0.006	U	
Arsenic	6010C	0.009	1.0	05/18/17	05/24/17	0.009	U	
Cadmium	6010C	0.0004	1.0	05/18/17	05/24/17	0.0004	U	
Chromium	6010C	0.004	1.0	05/18/17	05/24/17	0.007		
Copper	6010C	0.004	1.0	05/18/17	05/24/17	0.023		
Lead	6010C	0.002	1.0	05/18/17	05/24/17	0.026		
Mercury	7470A	0.00008	4.0	05/18/17	05/26/17	0.00008	U	
Nickel	6010C	0.002	1.0	05/18/17	05/24/17	0.008		
Silver	6010C	0.002	1.0	05/18/17	05/24/17	0.002	U	
Zinc	6010C	0.006	1.0	05/18/17	05/24/17	0.130		

% Solids: 79.1

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704543
Project No.: 1657231
Date Collected: 5/4/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/8/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-29
Lab Code: K1704543-006

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.011	1.0	05/18/17	05/24/17	0.011	U	
Arsenic	6010C	0.019	1.0	05/18/17	05/24/17	0.019	U	
Cadmium	6010C	0.0007	1.0	05/18/17	05/24/17	0.0032		
Chromium	6010C	0.007	1.0	05/18/17	05/24/17	0.028		
Copper	6010C	0.007	1.0	05/18/17	05/24/17	0.062		
Lead	6010C	0.004	1.0	05/18/17	05/24/17	0.044		
Mercury	7470A	0.00015	4.0	05/18/17	05/26/17	0.00015	U	
Nickel	6010C	0.004	1.0	05/18/17	05/24/17	0.036		
Silver	6010C	0.004	1.0	05/18/17	05/24/17	0.004	U	
Zinc	6010C	0.011	1.0	05/18/17	05/24/17	0.386		

% Solids: 50.1

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704543
Project No.: 1657231
Date Collected: 5/5/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/8/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-10
Lab Code: K1704543-007

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.007	1.0	05/18/17	05/24/17	0.007	U	
Arsenic	6010C	0.012	1.0	05/18/17	05/24/17	0.012	U	
Cadmium	6010C	0.0005	1.0	05/18/17	05/24/17	0.0005	U	
Chromium	6010C	0.005	1.0	05/18/17	05/24/17	0.009		
Copper	6010C	0.005	1.0	05/18/17	05/24/17	0.085		
Lead	6010C	0.002	1.0	05/18/17	05/24/17	0.235		
Mercury	7470A	0.00009	4.0	05/18/17	05/26/17	0.00009	U	
Nickel	6010C	0.002	1.0	05/18/17	05/24/17	0.006		
Silver	6010C	0.002	1.0	05/18/17	05/24/17	0.002	U	
Zinc	6010C	0.007	1.0	05/18/17	05/24/17	0.430		

% Solids: 77.0

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704543
Project No.: 1657231
Date Collected: 5/5/2017
Project Name: Skagway-Sediment 2017
Date Received: 5/8/2017
Matrix: SEDIMENT
Units: uMole/g
Basis: DRY

Sample Name: SED17-15
Lab Code: K1704543-008

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.006	1.0	05/18/17	05/24/17	0.006	U	
Arsenic	6010C	0.011	1.0	05/18/17	05/24/17	0.011	U	
Cadmium	6010C	0.0004	1.0	05/18/17	05/24/17	0.0005		
Chromium	6010C	0.004	1.0	05/18/17	05/24/17	0.009		
Copper	6010C	0.004	1.0	05/18/17	05/24/17	0.058		
Lead	6010C	0.002	1.0	05/18/17	05/24/17	0.103		
Mercury	7470A	0.00009	4.0	05/18/17	05/26/17	0.00009	U	
Nickel	6010C	0.002	1.0	05/18/17	05/24/17	0.007		
Silver	6010C	0.002	1.0	05/18/17	05/24/17	0.002	U	
Zinc	6010C	0.006	1.0	05/18/17	05/24/17	0.297		

% Solids: 78.8

Comments:

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Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc. **Service Request:** K1704543
Project No.: 1657231 **Date Collected:** 5/5/2017
Project Name: Skagway-Sediment 2017 **Date Received:** 5/8/2017
Matrix: SEDIMENT **Units:** uMole/g
Basis: DRY

Sample Name: SED17-27 **Lab Code:** K1704543-009

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.006	1.0	05/18/17	05/24/17	0.006	U	
Arsenic	6010C	0.011	1.0	05/18/17	05/24/17	0.011	U	
Cadmium	6010C	0.0004	1.0	05/18/17	05/24/17	0.0004	U	
Chromium	6010C	0.004	1.0	05/18/17	05/24/17	0.010		
Copper	6010C	0.004	1.0	05/18/17	05/24/17	0.008		
Lead	6010C	0.002	1.0	05/18/17	05/24/17	0.005		
Mercury	7470A	0.00009	4.0	05/18/17	05/26/17	0.00009	U	
Nickel	6010C	0.002	1.0	05/18/17	05/24/17	0.007		
Silver	6010C	0.002	1.0	05/18/17	05/24/17	0.002	U	
Zinc	6010C	0.006	1.0	05/18/17	05/24/17	0.064		

% Solids: 77.5

Comments:

Simultaneously Extactable Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.

Service Request: K1704543

Project No.: 1657231

Date Collected:

Project Name: Skagway-Sediment 2017

Date Received:

Matrix: SEDIMENT

Units: uMole/g

Basis: DRY

Sample Name: Method Blank

Lab Code: K1704543-MB

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Antimony	6010C	0.003	1.0	05/18/17	05/24/17	0.003	U	
Arsenic	6010C	0.005	1.0	05/18/17	05/24/17	0.005	U	
Cadmium	6010C	0.0002	1.0	05/18/17	05/24/17	0.0002	U	
Chromium	6010C	0.002	1.0	05/18/17	05/24/17	0.002	U	
Copper	6010C	0.002	1.0	05/18/17	05/24/17	0.002	U	
Lead	6010C	0.001	1.0	05/18/17	05/24/17	0.001	U	
Nickel	6010C	0.001	1.0	05/18/17	05/24/17	0.001	U	
Silver	6010C	0.001	1.0	05/18/17	05/24/17	0.001	U	
Zinc	6010C	0.003	1.0	05/18/17	05/24/17	0.003	U	

% Solids: 100.0

Comments:

Simultaneously Extactable Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Inc.
Service Request: K1704543
Project No.: 1657231
Date Collected:
Project Name: Skagway-Sediment 2017
Date Received:
Matrix: SEDIMENT
Units: umol/g
Basis: DRY

Sample Name: Method Blank
Lab Code: KQ1706321-01

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Mercury	7470A	0.00004	4.0	05/18/17	05/26/17	0.00004	U	

% Solids: 100.0

Comments:

Simultaneously Extactable Metals

- 5A -

SPIKE SAMPLE RECOVERY

Client: Golder Associates, Inc. **Service Request:** K1704543

Project No.: 1657231 **Units:** UMOLE/G

Project Name: Skagway-Sediment 2017 **Basis:** DRY

Matrix: SEDIMENT **% Solids:** 83.3

Sample Name: **SED17-07S** **Lab Code:** **K1704543-001S**

Analyte	Control Limit %R	Spike Result	C	Sample Result	C	Spike Added	%R	Q	Method
Antimony	75 - 125	0.080		0.006	U	0.087	92		6010C
Arsenic	75 - 125	0.694		0.011	U	0.705	98		6010C
Cadmium	75 - 125	0.2512		0.0004	U	0.234	107		6010C
Chromium	75 - 125	0.2038		0.0103		0.203	95		6010C
Copper	75 - 125	0.415		0.230		0.207	89		6010C
Lead	75 - 125	0.587		0.324		0.255	103		6010C
Mercury	75 - 125	0.00203		0.00008	U	0.00210	97		7470A
Nickel	75 - 125	0.484		0.007		0.447	107		6010C
Silver	75 - 125	0.111		0.002	U	0.122	91		6010C
Zinc	75 - 125	1.050		0.631		0.403	104		6010C

An empty field in the Control Limit column indicates the control limit is not applicable

Simultaneouslv Extactable Metals

- 6 -
DUPLICATES

Client: Golder Associates, Inc.
Service Request: K1704543
Project No.: 1657231
Units: UMOLE/G
Project Name: Skagway-Sediment 2017
Basis: DRY
Matrix: SEDIMENT
% Solids: 83.3

Sample Name: SED17-07D
Lab Code: K1704543-001D

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	Method
Antimony		0.006	U	0.007	U			6010C
Arsenic		0.011	U	0.012	U			6010C
Cadmium		0.0004	U	0.0015		200.0		6010C
Chromium		0.0103		0.0092		11.3		6010C
Copper	30	0.230		0.211		8.6		6010C
Lead	30	0.324		0.323		0.3		6010C
Mercury		0.00008	U	0.00009	U			7470A
Nickel		0.007		0.007		0.0		6010C
Silver		0.002	U	0.002	U			6010C
Zinc	30	0.631		0.647		2.5		6010C

An empty field in the Control Limit column indicates the control limit is not applicable.

ALS Group USA, Corp.
dba ALS Environmental

Simultaneously Extactable Metals
-7-
LABORATORY CONTROL SAMPLE

Client: Golder Associates, Inc. **Service Request:** K1704543

Project No.: 1657231

Project Name: Skagway-Sediment 2017

Aqueous LCS Source: ALS MIXED **Solid LCS Source:**

Analyte	Aqueous (umol/L)			Solid (mg/kg)				
	True	Found	%R	True	Found	C	Limits	%R
Antimony	4.100	3.898	95					
Arsenic	33.400	33.530	100					
Cadmium	11.100	11.061	100					
Chromium	9.610	9.336	97					
Copper	9.830	9.649	98					
Lead	12.100	11.857	98					
Mercury	0.09960	0.09360	94					
Nickel	21.200	21.197	100					
Silver	5.790	5.547	96					
Zinc	19.100	19.110	100					

Diesel and Residual Range Organics

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Diesel and Residual Range Organics

Sample Name:	SED17-07	**Units:**	mg/Kg
Lab Code:	K1704543-001	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	24	1	05/18/17	05/19/17	KWG1704041	
C25 - C36 RRO	ND	U	120	1	05/18/17	05/19/17	KWG1704041	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	68	50-150	05/19/17	Acceptable
n-Triacontane	66	50-150	05/19/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Diesel and Residual Range Organics

Sample Name:	SED17-12	**Units:**	mg/Kg
Lab Code:	K1704543-002	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	26	1	05/18/17	05/19/17	KWG1704041	
C25 - C36 RRO	ND	U	130	1	05/18/17	05/19/17	KWG1704041	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	89	50-150	05/19/17	Acceptable
n-Triacontane	89	50-150	05/19/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Diesel and Residual Range Organics

Sample Name:	SED17-01	**Units:**	mg/Kg
Lab Code:	K1704543-004	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	28	1	05/18/17	05/19/17	KWG1704041	
C25 - C36 RRO	ND	U	140	1	05/18/17	05/19/17	KWG1704041	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	85	50-150	05/19/17	Acceptable
n-Triacontane	86	50-150	05/19/17	Acceptable

Comments:

Analytical Results

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704543
Date Collected: 05/04/2017
Date Received: 05/08/2017

Diesel and Residual Range Organics

Sample Name: SED17-03
Lab Code: K1704543-005
Extraction Method: EPA 3550B
Analysis Method: AK 102.0/103.0

Units: mg/Kg
Basis: Dry
Level: Low

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	26	1	05/18/17	05/19/17	KWG1704041	
C25 - C36 RRO	ND	U	130	1	05/18/17	05/19/17	KWG1704041	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	70	50-150	05/19/17	Acceptable
n-Triacontane	71	50-150	05/19/17	Acceptable

Comments:

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Diesel and Residual Range Organics

Sample Name:	SED17-29	**Units:**	mg/Kg
Lab Code:	K1704543-006	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	37	1	05/18/17	05/24/17	KWG1704041	
C25 - C36 RRO	ND	U	190	1	05/18/17	05/24/17	KWG1704041	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	94	50-150	05/24/17	Acceptable
n-Triacontane	96	50-150	05/24/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/05/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Diesel and Residual Range Organics

Sample Name:	SED17-10	**Units:**	mg/Kg
Lab Code:	K1704543-007	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	26	1	05/18/17	05/19/17	KWG1704041	
C25 - C36 RRO	ND	U	130	1	05/18/17	05/19/17	KWG1704041	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	71	50-150	05/19/17	Acceptable
n-Triacontane	72	50-150	05/19/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/05/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Diesel and Residual Range Organics

Sample Name:	SED17-15	**Units:**	mg/Kg
Lab Code:	K1704543-008	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	26	1	05/18/17	05/19/17	KWG1704041	
C25 - C36 RRO	ND	U	130	1	05/18/17	05/19/17	KWG1704041	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	68	50-150	05/19/17	Acceptable
n-Triacontane	69	50-150	05/19/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/05/2017
Sample Matrix:	Sediment	**Date Received:**	05/08/2017

Diesel and Residual Range Organics

Sample Name:	SED17-27	**Units:**	mg/Kg
Lab Code:	K1704543-009	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	26	1	05/18/17	05/19/17	KWG1704041	
C25 - C36 RRO	ND	U	130	1	05/18/17	05/19/17	KWG1704041	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	70	50-150	05/19/17	Acceptable
n-Triacontane	70	50-150	05/19/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA

Diesel and Residual Range Organics

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1704041-5	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	20	1	05/18/17	05/19/17	KWG1704041	
C25 - C36 RRO	ND	U	99	1	05/18/17	05/19/17	KWG1704041	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	85	50-150	05/19/17	Acceptable
n-Triacontane	80	50-150	05/19/17	Acceptable

Comments:

QA/QC Report

Client: Golder Associates, Inc. **Service Request:** K1704543
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Surrogate Recovery Summary
Diesel and Residual Range Organics

Extraction Method: EPA 3550B **Units:** Percent
Analysis Method: AK 102.0/103.0 **Level:** Low

Sample Name	Lab Code	Sur1	Sur2
SED17-07	K1704543-001	68	66
SED17-12	K1704543-002	89	89
SED17-01	K1704543-004	85	86
SED17-03	K1704543-005	70	71
SED17-29	K1704543-006	94	96
SED17-10	K1704543-007	71	72
SED17-15	K1704543-008	68	69
SED17-27	K1704543-009	70	70
Method Blank	KWG1704041-5	85	80
SED17-07MS	KWG1704041-1	87	86
SED17-07DMS	KWG1704041-2	91	90
Lab Control Sample	KWG1704041-3	89	86
Duplicate Lab Control Sample	KWG1704041-4	89	86

Surrogate Recovery Control Limits (%)

Sur1	=	o-Terphenyl	50-150
Sur2	=	n-Triacontane	50-150

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Sediment

Service Request: K1704543
Date Extracted: 05/18/2017
Date Analyzed: 05/19/2017

Matrix Spike/Duplicate Matrix Spike Summary
Diesel and Residual Range Organics

Sample Name: SED17-07
Lab Code: K1704543-001
Extraction Method: EPA 3550B
Analysis Method: AK 102.0/103.0

Units: mg/Kg
Basis: Dry
Level: Low
Extraction Lot: KWG1704041

		SED17-07MS KWG1704041-1 **Matrix Spike**			SED17-07DMS KWG1704041-2 **Duplicate Matrix Spike**					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
C10 - C25 DRO	ND	298	318	94	302	317	95	60-140	1	50
C25 - C36 RRO	ND	157	159	99	162	158	102	60-140	3	50

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp. dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704543
Project:	Skagway-Sediment 2017/1657231	**Date Extracted:**	05/18/2017
Sample Matrix:	Sediment	**Date Analyzed:**	05/19/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Diesel and Residual Range Organics

Extraction Method:	EPA 3550B	**Units:**	mg/Kg
Analysis Method:	AK 102.0/103.0	**Basis:**	Dry
		Level:	Low
		Extraction Lot:	KWG1704041

	Lab Control Sample KWG1704041-3 **Lab Control Spike**			Duplicate Lab Control Sample KWG1704041-4 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
C10 - C25 DRO	248	267	93	241	267	90	75-125	3	20
C25 - C36 RRO	113	133	85	111	133	83	60-120	2	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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June 07, 2017

Analytical Report for Service Request No: K1704544

Tamra Reynolds
Golder Associates Ltd.
Suite 201C, 170 Titanium Way
Whitehorse, YT Y1A0G1

RE: Skagway-Sediment 2017 / 1657231

Dear Tamra,

Enclosed are the results of the sample(s) submitted to our laboratory May 08, 2017
For your reference, these analyses have been assigned our service request number **K1704544.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3364. You may also contact me via email at howard.holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Howard Holmes
Project Manager

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Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

- * The result is an outlier. See case narrative.
- \# The control limit criteria is not applicable. See case narrative.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- E The result is an estimate amount because the value exceeded the instrument calibration range.
- J The result is an estimated value.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.
- H The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

- \# The control limit criteria is not applicable. See case narrative.
- J The result is an estimated value.
- E The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
- M The duplicate injection precision was not met.
- N The Matrix Spike sample recovery is not within control limits. See case narrative.
- S The reported value was determined by the Method of Standard Additions (MSA).
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- W The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- \+ The correlation coefficient for the MSA is less than 0.995.
- Q See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

- * The result is an outlier. See case narrative.
- \# The control limit criteria is not applicable. See case narrative.
- A A tentatively identified compound, a suspected aldol-condensation product.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- C The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
- D The reported result is from a dilution.
- E The result is an estimated value.
- J The result is an estimated value.
- N The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
- P The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

- F The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
- L The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
- H The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
- O The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
- Y The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
- Z The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	**Web Site**	**Number**
Alaska DEH	http://dec.alaska.gov/eh/lab/cs/csapproval.htm	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	http://health.hawaii.gov/	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/page/la-lab-accreditation	03016
Maine DHS	http://www.maine.gov/dhhs/	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/enforcement/oqa.html	WA005
New York - DOH	https://www.wadsworth.org/regulatory/elap	12060
North Carolina DEQ	https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/EnvironmentalLabCertification/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water-	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS Environmental—Kelso Laboratory
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ALS ENVIRONMENTAL

Client:	Golder Associates	**Service Request No.:**	K1704544
Project:	Skagway-Sediment 2017/ 1657231	**Date Received:**	05/08/17
Sample Matrix:	Water		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt

Three water samples were received for analysis at ALS Environmental on 05/08/17. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry Parameters

No anomalies associated with the analysis of these samples were observed.

Total Metals

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for the replicate analysis of Aluminum in the Batch QC sample was outside the normal ALS control limits. The variability in the results was attributed to particulate material in the sample. The associated QA/QC results (e.g. control sample, matrix spike, method blank, calibration standards, etc.) indicate the analysis was in control. No further corrective action was appropriate.

No other anomalies associated with the analysis of these samples were observed.

Diesel and Residual Range Organics by Method AK102/ AK103

Sample Notes and Discussion:
Insufficient sample volume was received to perform a Matrix Spike/Matrix Spike Duplicate (MS/MSD). A Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS) was analyzed and reported in lieu of the MS/MSD for these samples.

No other anomalies associated with the analysis of these samples were observed.

Polynuclear Aromatic Hydrocarbons by EPA Method 8270

No anomalies associated with the analysis of these samples were observed.

Approved by________________________________

Chain of Custody

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

K1704544

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 - 594997

Page 1 of 4

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates LTD
Contact:	Tamra Reynolds
Phone:	1-867-334-4468
	Company address below will appear on the final report
Street:	170 - 201 C Titanium Way
City/Province:	Whitehorse, Yukon
Postal Code:	Y1A 0G1
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: TREYNOLDS@golder.com
Email 2: PADDY_MCMANUS@golder.com
Email 3: VMERCER@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: same as report
Email 2:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
PRIORITY (Business Days): 4 day [P4] ☑ ; 3 day [P3] ☐ ; 2 day [P2] ☐
EMERGENCY: 1 Business day [E1] ☐ ; Same Day, Weekend or Statutory holiday [E0] ☐
Date and Time Required for all E&P TATs:
For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: 41037
Job #: 1657231
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Royfer | Sampler: PM / JM

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals	PAHs	Grainsize (GS)	Total Organic Carbon (TOC)	DRO	AVS/SEM	Number of Containers
	SED17-07	04-MAY-17	10:00	Sediment	X	X	X	X			4
	SED17-12	↓	12:00	↓	↓	↓	↓	↓			↓
	DUP-3	↓	13:00	↓	↓	↓	↓	↓			↓
	SED17-01	↓	14:40	↓	↓	↓	↓	↓			↓
	SED17-03	↓	16:00	↓	↓	↓	↓	↓			↓
	SED17-29		1800	↓	↓	↓	↓	↓			↓
	SED17-10	05-MAY-17	9:00	↓	↓	↓	↓	↓			↓
	SED17-15	↓	10:00	↓	↓	↓	↓	↓			↓
	SED17-27	↓	12:00	↓	↓	↓	↓	↓			↓
	Travel Blank	04-MAY-17	18:00	water	↓	↓					5
	FB-1	↓	18:00	↓	↓	↓					↓
	EB-1	↓	18:00	↓	↓	↓					↓

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO
Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Please archive unused samples, 5-day turnaround on metals and PAHs, regular turnaround on GS and TOC, wait for directions for DRO and AVS/SEM.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐
INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 05-MAY-17	Time: 15:00	Received by: [signature]	Date: 5/8/17	Time: 0840	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS

PC H2

Cooler Receipt and Preservation Form

Client Golder Service Request K17 04544

Received: 5/8/17 Opened: 5/8/17 By: [illegible] Unloaded: 5/8/17 By: [illegible]

1. Samples were received via? USPS Fed Ex UPS DHL PDX **Courier** Hand Delivered
2. Samples were received in: (circle) **Cooler** Box Envelope Other ______ NA
3. Were custody seals on coolers? NA **Y** N If yes, how many and where? one, front
   If present, were custody seals intact? **Y** N If present, were they signed and dated? **Y** N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
2.1	2.1	3.4	3.4	0	298			✓
-2.1	-2.2	frozen	→	-0.1	372			

4. Packing material: Inserts **Baggies** ~~Bubble Wrap~~ **Gel Packs** Wet Ice Dry Ice Sleeves boxes
5. Were custody papers properly filled out (ink, signed, etc.)? NA **Y** N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA **Y** N
   If applicable, tissue samples were received: **Frozen** Partially Thawed Thawed
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA **Y** N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA **Y** N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA **Y** N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA **Y** N
11. Were VOA vials received without headspace? *Indicate in the table below.* **NA** Y N
12. Was C12/Res negative? **NA** Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions:

RUSH

7/25/16 *Page ____ of ____*

General Chemistry

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/4/17
Sample Matrix:	Water	**Date Received:**	05/8/17
Analysis Method:	9030M	**Units:**	mg/L
Prep Method:	EPA 9030B Modified	**Basis:**	NA

Sulfide, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Date Extracted	Q
Travel Blank	K1704544-001	ND U	0.10	1	05/11/17 17:55	5/11/17	
FB-1	K1704544-002	ND U	0.10	1	05/11/17 17:55	5/11/17	
EB-1	K1704544-003	ND U	0.10	1	05/11/17 17:55	5/11/17	
Method Blank	K1704544-MB1	ND U	0.10	1	05/11/17 17:55	5/11/17	

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Water	**Date Received:**	05/08/17
		Date Analyzed:	05/11/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	FB-1	**Units:**	mg/L
Lab Code:	K1704544-002	**Basis:**	NA

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1704544-002DUP Result	Average	RPD	RPD Limit
Sulfide, Total	9030M	0.10	ND U	ND U	NC	NC	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 5/24/2017 12:10:32 PM Superset Reference:17-0000421830 rev 00

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Water	**Date Received:**	05/08/17
		Date Analyzed:	05/11/17
		Date Extracted:	05/11/17

Duplicate Matrix Spike Summary
Sulfide, Total

Sample Name:	FB-1	**Units:**	mg/L
Lab Code:	K1704544-002	**Basis:**	NA
Analysis Method:	9030M		
Prep Method:	EPA 9030B Modified		

		Matrix Spike K1704544-002MS			Duplicate Matrix Spike K1704544-002DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Sulfide, Total	ND U	68	72	94	74	72	102	34-166	8	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/11/17
Sample Matrix:	Water	**Date Extracted:**	05/11/17

Lab Control Sample Summary
Sulfide, Total

Analysis Method:	9030M	**Units:**	mg/L
Prep Method:	EPA 9030B Modified	**Basis:**	NA
		Analysis Lot:	545389

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1704544-LCS1	1.17	1.44	81	55-130

Client:	Golder Associates, Inc.		**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231		**Date Collected:**	05/4/17
Sample Matrix:	Water		**Date Received:**	05/8/17
Analysis Method:	9060		**Units:**	mg/L
Prep Method:	None		**Basis:**	NA

Carbon, Total Organic

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
Travel Blank	K1704544-001	ND U	0.50	1	05/11/17 18:05	
FB-1	K1704544-002	ND U	0.50	1	05/11/17 19:00	
EB-1	K1704544-003	ND U	0.50	1	05/11/17 20:09	
Method Blank	K1704544-MB1	ND U	0.50	1	05/11/17 16:18	
Method Blank	K1704544-MB2	ND U	0.50	1	05/12/17 02:12	

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QA/QC Report

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Water

Service Request: K1704544
Date Collected: 5/4/17
Date Received: 5/8/17
Date Analyzed: 5/11/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name: Travel Blank
Lab Code: K1704544-001

Units: mg/L
Basis: NA

Analytical Method: 9060

Analyte Name	MRL	Sample Result	Duplicate Sample Result	Triplicate Sample Result	Quadruplicate Sample Result	Average	RSD	RSI Lim
Carbon, Total Organic	0.50	ND U	ND U	ND U	ND U	NC	NC	20

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/4/17
Sample Matrix:	Water	**Date Received:**	5/8/17
		Date Analyzed:	5/11/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	FB-1	**Units:**	mg/L
Lab Code:	K1704544-002	**Basis:**	NA

Analytical Method: 9060

Analyte Name	MRL	Sample Result	Duplicate Sample Result	Triplicate Sample Result	Quadruplicate Sample Result	Average	RSD	RSI Lim
Carbon, Total Organic	0.50	ND U	ND U	ND U	ND U	NC	NC	20

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	5/4/17
Sample Matrix:	Water	**Date Received:**	5/8/17
		Date Analyzed:	5/11/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	EB-1	**Units:**	mg/L
Lab Code:	K1704544-003	**Basis:**	NA

Analytical Method: 9060

Analyte Name	MRL	Sample Result	Duplicate Sample Result	Triplicate Sample Result	Quadruplicate Sample Result	Average	RSD	RSl Lim
Carbon, Total Organic	0.50	ND U	ND U	ND U	ND U	NC	NC	20

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Water	**Date Received:**	05/08/17
		Date Analyzed:	05/11/17
		Date Extracted:	NA

Matrix Spike Summary
Carbon, Total Organic

Sample Name:	FB-1	**Units:**	mg/L
Lab Code:	K1704544-002	**Basis:**	NA
Analysis Method:	9060		
Prep Method:	None		

Matrix Spike
K1704544-002MS

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Carbon, Total Organic	ND U	27.0	25.0	108	83-117

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Results flagged with a pound (#) indicate the control criteria is not applicable.

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Analyzed:**	05/11/17
Sample Matrix:	Water	**Date Extracted:**	NA

Lab Control Sample Summary
Carbon, Total Organic

Analysis Method:	9060	**Units:**	mg/L
Prep Method:	None	**Basis:**	NA
		Analysis Lot:	545392

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1704544-LCS1	25.7	24.0	107	83-117
Lab Control Sample	K1704544-LCS2	24.5	24.0	102	83-117

Metals

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17 18:00
Sample Matrix:	Water	**Date Received:**	05/08/17 08:40
Sample Name:	Travel Blank	**Basis:**	NA
Lab Code:	K1704544-001		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	ND U	ug/L	11	1	05/18/17 11:59	05/16/17	
Antimony	6020A	ND U	ug/L	0.050	1	06/02/17 19:39	05/16/17	
Arsenic	6020A	ND U	ug/L	0.50	1	06/02/17 19:39	05/16/17	
Barium	6010C	ND U	ug/L	4.2	1	05/18/17 11:59	05/16/17	
Beryllium	6020A	ND U	ug/L	0.020	1	06/02/17 19:39	05/16/17	
Cadmium	6020A	ND U	ug/L	0.020	1	06/02/17 19:39	05/16/17	
Calcium	6010C	ND U	ug/L	21	1	05/18/17 11:59	05/16/17	
Chromium	6020A	ND U	ug/L	0.20	1	06/02/17 19:39	05/16/17	
Cobalt	6020A	ND U	ug/L	0.020	1	06/02/17 19:39	05/16/17	
Copper	6020A	ND U	ug/L	0.10	1	06/02/17 19:39	05/16/17	
Iron	6010C	ND U	ug/L	21	1	05/18/17 11:59	05/16/17	
Lead	6020A	ND U	ug/L	0.020	1	06/02/17 19:39	05/16/17	
Magnesium	6010C	ND U	ug/L	5.3	1	05/18/17 11:59	05/16/17	
Manganese	6010C	**1.4**	ug/L	1.1	1	05/18/17 11:59	05/16/17	
Mercury	7470A	ND U	ug/L	0.20	1	05/18/17 11:39	05/17/17	
Nickel	6020A	ND U	ug/L	0.20	1	06/02/17 19:39	05/16/17	
Potassium	6010C	ND U	ug/L	420	1	05/18/17 11:59	05/16/17	
Selenium	6020A	ND U	ug/L	1.0	1	06/02/17 19:39	05/16/17	
Silver	6020A	ND U	ug/L	0.020	1	06/02/17 19:39	05/16/17	
Sodium	6010C	ND U	ug/L	210	1	05/18/17 11:59	05/16/17	
Thallium	6020A	ND U	ug/L	0.020	1	06/02/17 19:39	05/16/17	
Vanadium	6020A	ND U	ug/L	0.20	1	06/02/17 19:39	05/16/17	
Zinc	6010C	ND U	ug/L	4.2	1	05/18/17 11:59	05/16/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17 18:00
Sample Matrix:	Water	**Date Received:**	05/08/17 08:40
Sample Name:	FB-1	**Basis:**	NA
Lab Code:	K1704544-002		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	ND	U	ug/L	11	1	05/18/17 12:01	05/16/17	
Antimony	6020A	ND	U	ug/L	0.050	1	06/02/17 19:44	05/16/17	
Arsenic	6020A	ND	U	ug/L	0.50	1	06/02/17 19:44	05/16/17	
Barium	6010C	ND	U	ug/L	4.2	1	05/18/17 12:01	05/16/17	
Beryllium	6020A	ND	U	ug/L	0.020	1	06/02/17 19:44	05/16/17	
Cadmium	6020A	ND	U	ug/L	0.020	1	06/02/17 19:44	05/16/17	
Calcium	6010C	**71**		ug/L	21	1	05/18/17 12:01	05/16/17	
Chromium	6020A	ND	U	ug/L	0.20	1	06/02/17 19:44	05/16/17	
Cobalt	6020A	ND	U	ug/L	0.020	1	06/02/17 19:44	05/16/17	
Copper	6020A	ND	U	ug/L	0.10	1	06/02/17 19:44	05/16/17	
Iron	6010C	ND	U	ug/L	21	1	05/18/17 12:01	05/16/17	
Lead	6020A	ND	U	ug/L	0.020	1	06/02/17 19:44	05/16/17	
Magnesium	6010C	**11.3**		ug/L	5.3	1	05/18/17 12:01	05/16/17	
Manganese	6010C	**4.2**		ug/L	1.1	1	05/18/17 12:01	05/16/17	
Mercury	7470A	ND	U	ug/L	0.20	1	05/18/17 11:44	05/17/17	
Nickel	6020A	ND	U	ug/L	0.20	1	06/02/17 19:44	05/16/17	
Potassium	6010C	ND	U	ug/L	420	1	05/18/17 12:01	05/16/17	
Selenium	6020A	ND	U	ug/L	1.0	1	06/02/17 19:44	05/16/17	
Silver	6020A	ND	U	ug/L	0.020	1	06/02/17 19:44	05/16/17	
Sodium	6010C	ND	U	ug/L	210	1	05/18/17 12:01	05/16/17	
Thallium	6020A	ND	U	ug/L	0.020	1	06/02/17 19:44	05/16/17	
Vanadium	6020A	ND	U	ug/L	0.20	1	06/02/17 19:44	05/16/17	
Zinc	6010C	ND	U	ug/L	4.2	1	05/18/17 12:01	05/16/17	

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Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/17 18:00
Sample Matrix:	Water	**Date Received:**	05/08/17 08:40
Sample Name:	EB-1	**Basis:**	NA
Lab Code:	K1704544-003		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	**26**		ug/L	11	1	05/18/17 12:22	05/16/17	
Antimony	6020A	ND	U	ug/L	0.050	1	06/02/17 19:48	05/16/17	
Arsenic	6020A	ND	U	ug/L	0.50	1	06/02/17 19:48	05/16/17	
Barium	6010C	ND	U	ug/L	4.2	1	05/18/17 12:22	05/16/17	
Beryllium	6020A	ND	U	ug/L	0.020	1	06/02/17 19:48	05/16/17	
Cadmium	6020A	ND	U	ug/L	0.020	1	06/02/17 19:48	05/16/17	
Calcium	6010C	**98**		ug/L	21	1	05/18/17 12:22	05/16/17	
Chromium	6020A	ND	U	ug/L	0.20	1	06/02/17 19:48	05/16/17	
Cobalt	6020A	ND	U	ug/L	0.020	1	06/02/17 19:48	05/16/17	
Copper	6020A	**1.62**		ug/L	0.10	1	06/02/17 19:48	05/16/17	
Iron	6010C	**43**		ug/L	21	1	05/18/17 12:22	05/16/17	
Lead	6020A	**0.424**		ug/L	0.020	1	06/02/17 19:48	05/16/17	
Magnesium	6010C	**228**		ug/L	5.3	1	05/18/17 12:22	05/16/17	
Manganese	6010C	**1.2**		ug/L	1.1	1	05/18/17 12:22	05/16/17	
Mercury	7470A	ND	U	ug/L	0.20	1	05/18/17 11:45	05/17/17	
Nickel	6020A	ND	U	ug/L	0.20	1	06/02/17 19:48	05/16/17	
Potassium	6010C	ND	U	ug/L	420	1	05/18/17 12:22	05/16/17	
Selenium	6020A	ND	U	ug/L	1.0	1	06/02/17 19:48	05/16/17	
Silver	6020A	ND	U	ug/L	0.020	1	06/02/17 19:48	05/16/17	
Sodium	6010C	**1890**		ug/L	210	1	05/18/17 12:22	05/16/17	
Thallium	6020A	ND	U	ug/L	0.020	1	06/02/17 19:48	05/16/17	
Vanadium	6020A	ND	U	ug/L	0.20	1	06/02/17 19:48	05/16/17	
Zinc	6010C	ND	U	ug/L	4.2	1	05/18/17 12:22	05/16/17	

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Analytical Report

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Water

Service Request: K1704544
Date Collected: NA
Date Received: NA

Sample Name: Method Blank
Lab Code: KQ1705866-02

Basis: NA

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6010C	ND U	ug/L	11	1	05/18/17 11:54	05/16/17	
Barium	6010C	ND U	ug/L	4.2	1	05/18/17 11:54	05/16/17	
Calcium	6010C	ND U	ug/L	21	1	05/18/17 11:54	05/16/17	
Iron	6010C	ND U	ug/L	21	1	05/18/17 11:54	05/16/17	
Magnesium	6010C	ND U	ug/L	5.3	1	05/18/17 11:54	05/16/17	
Manganese	6010C	ND U	ug/L	1.1	1	05/18/17 11:54	05/16/17	
Potassium	6010C	ND U	ug/L	420	1	05/18/17 11:54	05/16/17	
Sodium	6010C	ND U	ug/L	210	1	05/18/17 11:54	05/16/17	
Zinc	6010C	ND U	ug/L	4.2	1	05/18/17 11:54	05/16/17	

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Superset Reference:

Client: Golder Associates, Inc.
Service Request: K1704544
Project: Skagway-Sediment 2017/1657231
Date Collected: NA
Sample Matrix: Water
Date Received: NA

Sample Name: Method Blank
Basis: NA
Lab Code: KQ1705868-01

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Antimony	6020A	ND U	ug/L	0.050	1	06/02/17 18:24	05/16/17	
Arsenic	6020A	ND U	ug/L	0.50	1	06/02/17 18:24	05/16/17	
Beryllium	6020A	ND U	ug/L	0.020	1	06/02/17 18:24	05/16/17	
Cadmium	6020A	ND U	ug/L	0.020	1	06/02/17 18:24	05/16/17	
Chromium	6020A	ND U	ug/L	0.20	1	06/02/17 18:24	05/16/17	
Cobalt	6020A	ND U	ug/L	0.020	1	06/02/17 18:24	05/16/17	
Copper	6020A	ND U	ug/L	0.10	1	06/02/17 18:24	05/16/17	
Lead	6020A	ND U	ug/L	0.020	1	06/02/17 18:24	05/16/17	
Nickel	6020A	ND U	ug/L	0.20	1	06/02/17 18:24	05/16/17	
Selenium	6020A	ND U	ug/L	1.0	1	06/02/17 18:24	05/16/17	
Silver	6020A	ND U	ug/L	0.020	1	06/02/17 18:24	05/16/17	
Thallium	6020A	ND U	ug/L	0.020	1	06/02/17 18:24	05/16/17	
Vanadium	6020A	ND U	ug/L	0.20	1	06/02/17 18:24	05/16/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	KQ1705871-03		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Mercury	7470A	ND U	ug/L	0.20	1	05/18/17 11:36	05/17/17	

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Superset Reference:

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	05/18/17

Replicate Sample Summary
Total Metals

Sample Name:	Batch QC	**Units:**	ug/L
Lab Code:	K1704651-001	**Basis:**	NA

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1705866-03 Result	Average	RPD	RPD Limit
Aluminum	6010C	11	191	240	216	23 *	20
Barium	6010C	4.2	61.2	61.4	61.3	<1	20
Calcium	6010C	21	59800	59900	59900	<1	20
Iron	6010C	21	652	660	656	1	20
Magnesium	6010C	5.3	26900	27200	27000	1	20
Manganese	6010C	1.1	670	673	672	<1	20
Potassium	6010C	420	2180	2170	2180	<1	20
Sodium	6010C	210	18400	18600	18500	<1	20
Zinc	6010C	4.2	13.2	13.3	13.3	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 06/05/17 10:27:31 AM Superset Reference:

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	06/02/17

Replicate Sample Summary
Total Metals

Sample Name:	Batch QC	**Units:**	ug/L
Lab Code:	K1704651-001	**Basis:**	NA

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1705868-03 Result	Average	RPD	RPD Limit
Antimony	6020A	0.050	ND U	ND U	ND	-	20
Arsenic	6020A	0.50	ND U	ND U	ND	-	20
Beryllium	6020A	0.020	0.164	0.176	0.170	7	20
Cadmium	6020A	0.020	0.093	0.086	0.089	7	20
Chromium	6020A	0.20	ND U	ND U	ND	-	20
Cobalt	6020A	0.020	7.62	8.12	7.87	6	20
Copper	6020A	0.10	1.05	1.10	1.07	5	20
Lead	6020A	0.020	0.033	0.036	0.035	8	20
Nickel	6020A	0.20	9.19	9.61	9.40	4	20
Selenium	6020A	1.0	ND U	ND U	ND	-	20
Silver	6020A	0.020	ND U	ND U	ND	-	20
Thallium	6020A	0.020	ND U	ND U	ND	-	20
Vanadium	6020A	0.20	ND U	ND U	ND	-	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 06/05/17 10:27:32 AM

Superset Reference:

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	05/18/17

Replicate Sample Summary
Total Metals

Sample Name:	Batch QC	**Units:**	ug/L
Lab Code:	K1704690-001	**Basis:**	NA

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1705871-01 Result	Average	RPD	RPD Limit
Mercury	7470A	0.20	ND U	ND U	ND	-	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 06/05/17 10:27:32 AM Superset Reference:

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	05/18/17
		Date Extracted:	05/16/17

Matrix Spike Summary
Total Metals

Sample Name:	Batch QC	**Units:**	ug/L
Lab Code:	K1704651-001	**Basis:**	NA
Analysis Method:	6010C		
Prep Method:	EPA CLP-METALS ILM04.0		

Matrix Spike
KQ1705866-04

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	191	2040	2000	92	75-125
Aluminum	191	2220	2000	101	75-125
Barium	61.2	1170	1000	111	75-125
Calcium	59800	70000	10000	102 #	75-125
Iron	652	1620	1000	97	75-125
Magnesium	26900	36800	10000	98	75-125
Manganese	670	1160	500	98	75-125
Potassium	2180	12000	10000	99	75-125
Sodium	18400	28700	10000	103	75-125
Zinc	13.2	505	500	98	75-125

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Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	06/2/17
		Date Extracted:	05/16/17

Matrix Spike Summary
Total Metals

Sample Name:	Batch QC	**Units:**	ug/L
Lab Code:	K1704651-001	**Basis:**	NA
Analysis Method:	6020A		
Prep Method:	EPA CLP-METALS ILM04.0		

Matrix Spike
KQ1705868-04

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Antimony	ND U	52.2	50.0	104	75-125
Arsenic	ND U	54.4	50.0	109	75-125
Beryllium	0.164	2.53	2.50	95	75-125
Cadmium	0.093	25.1	25.0	100	75-125
Chromium	ND U	10.9	10.0	108	75-125
Cobalt	7.62	34.3	25.0	107	75-125
Copper	1.05	13.7	12.5	101	75-125
Lead	0.033	47.3	50.0	95	75-125
Nickel	9.19	34.6	25.0	102	75-125
Selenium	ND U	54.8	50.0	110	75-125
Silver	ND U	12.2	12.5	97	75-125
Thallium	ND U	48.5	50.0	97	75-125
Vanadium	ND U	27.8	25.0	111	75-125

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 06/05/17 10:27:32 AM Superset Reference:

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	05/18/17
		Date Extracted:	05/17/17

Matrix Spike Summary
Total Metals

Sample Name:	Batch QC	**Units:**	ug/L
Lab Code:	K1704690-001	**Basis:**	NA
Analysis Method:	7470A		
Prep Method:	Method		

Matrix Spike
KQ1705871-02

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Mercury	ND U	4.90	5.00	96	75-125

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 06/05/17 10:27:32 AM Superset Reference:

Client: Golder Associates, Inc. **Service Request:** K1704544
Project: Skagway-Sediment 2017/1657231 **Date Analyzed:** 05/18/17
Sample Matrix: Water

Lab Control Sample Summary
Total Metals

Units:ug/L
Basis:NA

Lab Control Sample
KQ1705866-01

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6010C	5500	5000	110	80-120
Barium	6010C	5770	5000	115	80-120
Calcium	6010C	13500	12500	108	80-120
Iron	6010C	2620	2500	105	80-120
Magnesium	6010C	12700	12500	102	80-120
Manganese	6010C	1300	1250	104	80-120
Potassium	6010C	13100	12500	105	80-120
Sodium	6010C	13300	12500	106	80-120
Zinc	6010C	1320	1250	105	80-120

Client: Golder Associates, Inc.
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Water

Service Request: K1704544
Date Analyzed: 06/02/17

Lab Control Sample Summary
Total Metals

Units:ug/L
Basis:NA

Lab Control Sample
KQ1705868-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Antimony	6020A	53.5	50.0	107	80-120
Arsenic	6020A	54.4	50.0	109	80-120
Beryllium	6020A	2.76	2.50	110	80-120
Cadmium	6020A	26.5	25.0	106	80-120
Chromium	6020A	11.2	10.0	112	80-120
Cobalt	6020A	27.8	25.0	111	80-120
Copper	6020A	13.8	12.5	110	80-120
Lead	6020A	50.6	50.0	101	80-120
Nickel	6020A	27.5	25.0	110	80-120
Selenium	6020A	58.0	50.0	116	80-120
Silver	6020A	12.8	12.5	103	80-120
Thallium	6020A	50.7	50.0	101	80-120
Vanadium	6020A	27.1	25.0	109	80-120

Client: Golder Associates, Inc. **Service Request:** K1704544
Project: Skagway-Sediment 2017/1657231 **Date Analyzed:** 05/18/17
Sample Matrix: Water

Lab Control Sample Summary
Total Metals

Units:ug/L
Basis:NA

Lab Control Sample
KQ1705871-04

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Mercury	7470A	5.13	5.00	103	80-120

Diesel and Residual Range Organics

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Water	**Date Received:**	05/08/2017

Diesel and Residual Range Organics

Sample Name:	Travel Blank	**Units:**	ug/L
Lab Code:	K1704544-001	**Basis:**	NA
Extraction Method:	EPA 3510C	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	740	1	05/15/17	05/16/17	KWG1703880	
C25 - C36 RRO	ND	U	460	1	05/15/17	05/16/17	KWG1703880	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	73	50-150	05/16/17	Acceptable
n-Triacontane	70	50-150	05/16/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Water	**Date Received:**	05/08/2017

Diesel and Residual Range Organics

Sample Name:	FB-1	**Units:**	ug/L
Lab Code:	K1704544-002	**Basis:**	NA
Extraction Method:	EPA 3510C	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	730	1	05/15/17	05/16/17	KWG1703880	
C25 - C36 RRO	ND	U	450	1	05/15/17	05/16/17	KWG1703880	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	93	50-150	05/16/17	Acceptable
n-Triacontane	89	50-150	05/16/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Water	**Date Received:**	05/08/2017

Diesel and Residual Range Organics

Sample Name:	EB-1	**Units:**	ug/L
Lab Code:	K1704544-003	**Basis:**	NA
Extraction Method:	EPA 3510C	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	730	1	05/15/17	05/16/17	KWG1703880	
C25 - C36 RRO	ND	U	450	1	05/15/17	05/16/17	KWG1703880	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	93	50-150	05/16/17	Acceptable
n-Triacontane	87	50-150	05/16/17	Acceptable

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA

Diesel and Residual Range Organics

Sample Name:	Method Blank	**Units:**	ug/L
Lab Code:	KWG1703880-3	**Basis:**	NA
Extraction Method:	EPA 3510C	**Level:**	Low
Analysis Method:	AK 102.0/103.0		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
C10 - C25 DRO	ND	U	730	1	05/15/17	05/16/17	KWG1703880	
C25 - C36 RRO	ND	U	450	1	05/15/17	05/16/17	KWG1703880	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	91	50-150	05/16/17	Acceptable
n-Triacontane	89	50-150	05/16/17	Acceptable

Comments:

Client: Golder Associates, Inc.
Service Request: K1704544
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Water

Surrogate Recovery Summary
Diesel and Residual Range Organics

Extraction Method: EPA 3510C
Units: Percent
Analysis Method: AK 102.0/103.0
Level: Low

Sample Name	Lab Code	Sur1	Sur2
Travel Blank	K1704544-001	73	70
FB-1	K1704544-002	93	89
EB-1	K1704544-003	93	87
Method Blank	KWG1703880-3	91	89
Lab Control Sample	KWG1703880-1	90	88
Duplicate Lab Control Sample	KWG1703880-2	83	78

Surrogate Recovery Control Limits (%)

Sur1	=	o-Terphenyl	50-150
Sur2	=	n-Triacontane	50-150

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Extracted:**	05/15/2017
Sample Matrix:	Water	**Date Analyzed:**	05/16/2017 - 05/19/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Diesel and Residual Range Organics

Extraction Method:	EPA 3510C	**Units:**	ug/L
Analysis Method:	AK 102.0/103.0	**Basis:**	NA
		Level:	Low
		Extraction Lot:	KWG1703880

	Lab Control Sample KWG1703880-1 **Lab Control Spike**			Duplicate Lab Control Sample KWG1703880-2 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
C10 - C25 DRO	5310	6400	83	4890	6400	76	75-125	8	20
C25 - C36 RRO	2710	3200	85	2520	3200	79	60-120	7	20

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Polynuclear Aromatic Hydrocarbons

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Water	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	Travel Blank	**Units:**	ug/L
Lab Code:	K1704544-001	**Basis:**	NA
Extraction Method:	EPA 3520C	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
2-Methylnaphthalene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Acenaphthylene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Acenaphthene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Dibenzofuran	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Fluorene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Phenanthrene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Anthracene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Fluoranthene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Pyrene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Benz(a)anthracene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Chrysene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Benzo(b)fluoranthene†	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Benzo(k)fluoranthene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Benzo(a)pyrene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Indeno(1,2,3-cd)pyrene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Dibenz(a,h)anthracene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Benzo(g,h,i)perylene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	79	42-131	05/15/17	Acceptable
Fluoranthene-d10	87	42-133	05/15/17	Acceptable
Terphenyl-d14	85	32-129	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Water	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	FB-1	**Units:**	ug/L
Lab Code:	K1704544-002	**Basis:**	NA
Extraction Method:	EPA 3520C	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
2-Methylnaphthalene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Acenaphthylene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Acenaphthene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Dibenzofuran	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Fluorene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Phenanthrene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Anthracene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Fluoranthene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Pyrene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Benz(a)anthracene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Chrysene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Benzo(b)fluoranthene†	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Benzo(k)fluoranthene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Benzo(a)pyrene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Indeno(1,2,3-cd)pyrene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Dibenz(a,h)anthracene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	
Benzo(g,h,i)perylene	ND	U	0.021	1	05/11/17	05/15/17	KWG1703807	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	76	42-131	05/15/17	Acceptable
Fluoranthene-d10	80	42-133	05/15/17	Acceptable
Terphenyl-d14	80	32-129	05/15/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Water	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	EB-1	**Units:**	ug/L
Lab Code:	K1704544-003	**Basis:**	NA
Extraction Method:	EPA 3520C	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
2-Methylnaphthalene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Acenaphthylene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Acenaphthene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Dibenzofuran	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Fluorene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Phenanthrene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Anthracene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Fluoranthene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Pyrene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Benz(a)anthracene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Chrysene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Benzo(b)fluoranthene†	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Benzo(k)fluoranthene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Benzo(a)pyrene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Indeno(1,2,3-cd)pyrene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Dibenz(a,h)anthracene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	
Benzo(g,h,i)perylene	ND	U	0.020	1	05/11/17	05/15/17	KWG1703807	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	86	42-131	05/15/17	Acceptable
Fluoranthene-d10	91	42-133	05/15/17	Acceptable
Terphenyl-d14	91	32-129	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA

Polynuclear Aromatic Hydrocarbons

Sample Name:	Method Blank	**Units:**	ug/L
Lab Code:	KWG1703807-3	**Basis:**	NA
Extraction Method:	EPA 3520C	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
2-Methylnaphthalene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Acenaphthylene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Acenaphthene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Dibenzofuran	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Fluorene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Phenanthrene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Anthracene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Fluoranthene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Pyrene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Benz(a)anthracene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Chrysene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Benzo(b)fluoranthene†	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Benzo(k)fluoranthene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Benzo(a)pyrene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Indeno(1,2,3-cd)pyrene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Dibenz(a,h)anthracene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	
Benzo(g,h,i)perylene	ND	U	0.010	1	05/11/17	05/15/17	KWG1703807	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	80	42-131	05/15/17	Acceptable
Fluoranthene-d10	90	42-133	05/15/17	Acceptable
Terphenyl-d14	86	32-129	05/15/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

ALS Group USA, Corp. dba ALS Environmental

QA/QC Report

Client: Golder Associates, Inc. **Service Request:** K1704544
Project: Skagway-Sediment 2017/1657231
Sample Matrix: Water

Surrogate Recovery Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3520C **Units:** Percent
Analysis Method: 8270D SIM **Level:** Low

Sample Name	Lab Code	Sur1	Sur2	Sur3
Travel Blank	K1704544-001	79	87	85
FB-1	K1704544-002	76	80	80
EB-1	K1704544-003	86	91	91
Method Blank	KWG1703807-3	80	90	86
Lab Control Sample	KWG1703807-1	89	98	94
Duplicate Lab Control Sample	KWG1703807-2	87	95	90

Surrogate Recovery Control Limits (%)

Sur1	=	Fluorene-d10	42-131
Sur2	=	Fluoranthene-d10	42-133
Sur3	=	Terphenyl-d14	32-129

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704544
Project:	Skagway-Sediment 2017/1657231	**Date Extracted:**	05/11/2017
Sample Matrix:	Water	**Date Analyzed:**	05/15/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method:	EPA 3520C	**Units:**	ug/L
Analysis Method:	8270D SIM	**Basis:**	NA
		Level:	Low
		Extraction Lot:	KWG1703807

	Lab Control Sample KWG1703807-1 **Lab Control Spike**			Duplicate Lab Control Sample KWG1703807-2 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	2.12	2.50	85	2.05	2.50	82	52-115	3	30
2-Methylnaphthalene	1.92	2.50	77	1.96	2.50	78	48-120	2	30
Acenaphthylene	2.11	2.50	85	2.04	2.50	82	58-124	4	30
Acenaphthene	2.00	2.50	80	1.97	2.50	79	63-121	1	30
Dibenzofuran	2.12	2.50	85	2.06	2.50	82	56-132	3	30
Fluorene	2.09	2.50	84	2.01	2.50	81	68-121	4	30
Phenanthrene	2.14	2.50	86	2.07	2.50	83	64-126	3	30
Anthracene	2.11	2.50	84	2.00	2.50	80	68-127	6	30
Fluoranthene	2.19	2.50	88	2.13	2.50	85	70-127	3	30
Pyrene	2.22	2.50	89	2.11	2.50	84	72-127	5	30
Benz(a)anthracene	2.14	2.50	86	2.06	2.50	83	74-124	4	30
Chrysene	2.16	2.50	86	2.07	2.50	83	74-132	4	30
Benzo(b)fluoranthene	2.36	2.50	94	2.27	2.50	91	73-136	4	30
Benzo(k)fluoranthene	2.24	2.50	90	2.15	2.50	86	74-134	4	30
Benzo(a)pyrene	2.27	2.50	91	2.19	2.50	87	75-131	4	30
Indeno(1,2,3-cd)pyrene	2.33	2.50	93	2.24	2.50	90	63-136	4	30
Dibenz(a,h)anthracene	2.21	2.50	88	2.11	2.50	85	59-135	4	30
Benzo(g,h,i)perylene	2.17	2.50	87	2.10	2.50	84	63-127	3	30

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Environmental
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June 01, 2017

Analytical Report for Service Request No: K1704545

Tamra Reynolds
Golder Associates Ltd.
Suite 201C, 170 Titanium Way
Whitehorse, YT Y1A0G1

RE: Skagway Tissue / 1657231

Dear Tamra,

Enclosed are the results of the sample(s) submitted to our laboratory May 08, 2017
For your reference, these analyses have been assigned our service request number **K1704545.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3364. You may also contact me via email at howard.holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Howard Holmes
Project Manager

ALS Environmental
ALS Group USA, Corp
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Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- E The result is an estimate amount because the value exceeded the instrument calibration range.
- J The result is an estimated value.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.
- H The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

- # The control limit criteria is not applicable. See case narrative.
- J The result is an estimated value.
- E The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
- M The duplicate injection precision was not met.
- N The Matrix Spike sample recovery is not within control limits. See case narrative.
- S The reported value was determined by the Method of Standard Additions (MSA).
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- W The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- + The correlation coefficient for the MSA is less than 0.995.
- Q See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- A A tentatively identified compound, a suspected aldol-condensation product.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- C The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
- D The reported result is from a dilution.
- E The result is an estimated value.
- J The result is an estimated value.
- N The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
- P The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
  DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

- F The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
- L The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
- H The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
- O The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
- Y The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
- Z The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEH	http://dec.alaska.gov/eh/lab/cs/csapproval.htm	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	http://health.hawaii.gov/	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/page/la-lab-accreditation	03016
Maine DHS	http://www.maine.gov/dhhs/	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/enforcement/oqa.html	WA005
New York - DOH	https://www.wadsworth.org/regulatory/elap	12060
North Carolina DEQ	https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/EnvironmentalLabCertification/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water-	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory’s NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

ALS ENVIRONMENTAL

Client:	Golder Associates, Inc.	**Service Request No.:**	K1704545
Project:	Skagway Tissue/ 1657231	**Date Received:**	05/08/17
Sample Matrix:	Animal Tissue		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt

Thirty-four animal tissue samples were received for analysis at ALS Environmental on 05/08/17. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored frozen at –20ºC upon receipt at the laboratory. Homogenization and Rinsate blanks were created at the laboratory and analyzed.

Total Metals Tissue:

Matrix Spike Recovery Exceptions:
The matrix spike recovery of Iron for sample NF-CRAB-02 was outside control criteria. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. No further corrective action was appropriate.

The matrix spike recovery of Silver for sample REF-CRAB-03 was outside control criteria. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. No further corrective action was appropriate.

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for the replicate analysis of Calcium and Iron in sample NF-CRAB-02 was outside the Method control limits. The variability in the results was attributed to the heterogeneous distribution of Calcium and Iron in the sample. Freeze drying, grinding in combination with standard mixing techniques were used, but were not sufficient for complete homogenization of this sample.

No other anomalies associated with the analysis of these samples were observed.

Total Metals Water:

Matrix Spike Recovery Exceptions:
The matrix spike recovery of Manganese for the Batch QC sample was outside control criteria. However, the analyzed concentration in this sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicates the analytical batch was in control. No further corrective action was appropriate.

Approved by________________________________

The matrix spike recovery of Mercury for sample Homog. Blank was outside control criteria. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. No further corrective action was appropriate.

No other anomalies associated with the analysis of these samples were observed.

<u>Polynuclear Aromatic Hydrocarbons by EPA Method 8270</u>

No anomalies associated with the analysis of these samples were observed.

Approved by____

Chain of Custody

ALS Environmental—Kelso Laboratory
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www.alsglobal.com

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

K1704545

COC Number: 15 - 593817

Page 2 of 4

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd
Contact:	Tamre Reynolds
Phone:	1-877-334-4468
	Company address below will appear on the final report
Street:	170 - 201C Titanium Way
City/Province:	Whitehorse Yukon
Postal Code:	Y1A 0G1
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: TJREYNOLDS@golder.com
Email 2: PADDY_MCMANUS@golder.com
Email 3: VMERCER@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: same as report
Email 2:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☑ ; 3 day [P3] ☐ ; 2 day [P2] ☐
EMERGENCY: 1 Business day [E1] ☐ ; Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: 41117
Job #: 1657231
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Payfair | Sampler: PM/SM

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Hold	Metals	PAHs	DRO	Number of Containers
1	NF-PRAWN-01	03-MAY-17	—	Tissue		X	X		1
2	NF-PRAWN-02	03-MAY-17							
3	NF-PRAWN-03	04-MAY-17							
4	NF-PRAWN-04	04-MAY-17							
5	NF-PRAWN-05	04-MAY-17							
6	NF-MUSSEL-01	29-APR-17							
7	NF-MUSSEL-02	29-APR-17							
8	NF-MUSSEL-03	29-APR-17							
9	NF-MUSSEL-04	29-APR-17							
10	NF-MUSSEL-05	29-APR-17							
11	NF-CRAB-01	01-MAY-17							
12	NF-CRAB-02	04-MAY-17							

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO
Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Tissue is to be homogenized and an aliquot of the homogenate is to be analyzed. Please archive remaining sample and contact Golder prior to disposal.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 05-MAY-17	Time: 15:00	Received by: [signature]	Date: 5/8/17	Time: 0840	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

K1704545

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 - 593818

Page 3 of 4

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates LTD
Contact:	Tamra REYNOLDS
Phone:	1-867-334-4468
	Company address below will appear on the final report
Street:	170 - 201 C Titanium Way
City/Province:	Whitehorse, Yukon
Postal Code:	Y1A 0G1
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: TJREYNOLDS@GOLDER.COM
Email 2: UMERCER@GOLDER.COM
Email 3: PADDY_MCMANUS@Golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: same as report
Email 2:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☑; 3 day [P3] ☐; 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐; Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: 41117
Job #: 1657231
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Poyton | Sampler: JM / PM

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals	PAHs	Number of Containers
13	NF-CRAB-03	04-MAY-17	—	Tissue	X	X	1
14	MF-CRAB-01	03-MAY-17					
15	MF-CRAB-02	03-MAY-17					
16	MF-CRAB-03	03-MAY-17					
17	MF-CRAB-04	03-MAY-17					
18	MF-CRAB-05	03-MAY-17					
19	FF-MUSSEL-01	29-APR-17					
20	FF-MUSSEL-02	29					
21	FF-MUSSEL-03	29					
22	FF-MUSSEL-04	29					
23	FF-MUSSEL-05	29					
24	REF-MUSSEL-01	29-MAY-17					

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Regular priority for all tissue samples. See COC 15-593817 for specific instructions.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 05-MAY-17	Time: 1500	Received by: [signature]	Date: 5/8/17	Time: 0840	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION   WHITE - LABORATORY COPY   YELLOW - CLIENT COPY   OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

K1704545

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 - 593654

Page 4 of 4

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates LTD
Contact:	TAMRA REYNOLDS
Phone:	1-877-334-4468
	Company address below will appear on the final report
Street:	170 - 201C Titanium Way
City/Province:	Whitehorse, Yukon
Postal Code:	Y1A 0G1
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: TJREYNOLDS@GOLDER.COM
Email 2: PADDY_MCMANUS@GOLDER.COM
Email 3: JMERCER@GOLDER.COM

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: Same as Report
Email 2:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☑; 3 day [P3] ☐; 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐; Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: 41117
Job #: 1657231
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#:
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Todd Poyfair
Sampler: PM / JM

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals	PAHs	Number of Containers
25	REF-MUSSEL-02	29-APR-17		Tissue	X	X	1
26	REF-MUSSEL-03	29					
27	REF-MUSSEL-04	29					
28	REF-MUSSEL-05	29					
29	REF-PRAWN-01	04-MAY-17					
30	REF-PRAWN-02	05-MAY-17					
31	REF-PRAWN-03	05-MAY-17					
32	REF-CRAB-01	29-APR-17					
33	REF-CRAB-02	29-APR-17					
34	REF-CRAB-03	05-MAY-17					

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Regular priority for all tissue samples. Please see COC 15-593817 for specific instructions

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 05-MAY-17	Time: 15:00	Received by: [signature]	Date: 5/8/17	Time: 0840	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

ALS

PC H2

Cooler Receipt and Preservation Form

Client Golder Service Request K17 04545

Received: 5/8/17 Opened: 5/8/17 By: [signature] Unloaded: 5/8/17 By: [signature]

1. Samples were received via? *USPS* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* ______ *NA*
3. Were custody seals on coolers? NA **Y** N If yes, how many and where? one, front

   If present, were custody seals intact? **Y** N If present, were they signed and dated? **Y** N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
2.1	2.1	3.4	3.4	0	298			✓
-2.1	-2.2	frozen	→	-0.1	372			

4. Packing material: *Inserts* *Baggies* ~~*Bubble Wrap*~~ *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* boxes
5. Were custody papers properly filled out (ink, signed, etc.)? NA **Y** N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA **Y** N

   If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA **Y** N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA **Y** N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA **Y** N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA **Y** N
11. Were VOA vials received without headspace? *Indicate in the table below.* **NA** Y N
12. Was C12/Res negative? **NA** Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions:

RUSH

7/25/16

Page ____ *of* ____

Total Solids

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17 - 05/05/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/8/17
Analysis Method:	Calculation	**Units:**	Percent
Prep Method:	None	**Basis:**	Wet

Moisture

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
NF-PRAWN-01	K1704545-001	**73.6**	-	1	05/16/17 13:15	
NF-PRAWN-02	K1704545-002	**78.4**	-	1	05/16/17 13:15	
NF-PRAWN-03	K1704545-003	**79.0**	-	1	05/16/17 13:15	
NF-PRAWN-04	K1704545-004	**83.1**	-	1	05/16/17 13:15	
NF-PRAWN-05	K1704545-005	**81.9**	-	1	05/16/17 13:15	
NF-MUSSEL-01	K1704545-006	**81.4**	-	1	05/16/17 13:15	
NF-MUSSEL-02	K1704545-007	**79.4**	-	1	05/16/17 13:15	
NF-MUSSEL-03	K1704545-008	**81.1**	-	1	05/16/17 13:15	
NF-MUSSEL-04	K1704545-009	**80.2**	-	1	05/16/17 13:15	
NF-MUSSEL-05	K1704545-010	**78.9**	-	1	05/16/17 13:15	
NF-CRAB-01	K1704545-011	**78.6**	-	1	05/16/17 13:15	
NF-CRAB-02	K1704545-012	**79.1**	-	1	05/16/17 13:15	
NF-CRAB-03	K1704545-013	**79.9**	-	1	05/16/17 13:15	
MF-CRAB-01	K1704545-014	**79.2**	-	1	05/16/17 13:15	
MF-CRAB-02	K1704545-015	**86.5**	-	1	05/16/17 13:15	
MF-CRAB-03	K1704545-016	**83.7**	-	1	05/16/17 13:15	
MF-CRAB-04	K1704545-017	**78.9**	-	1	05/16/17 13:15	
MF-CRAB-05	K1704545-018	**86.1**	-	1	05/16/17 13:15	
FF-MUSSEL-01	K1704545-019	**79.6**	-	1	05/16/17 13:15	
FF-MUSSEL-02	K1704545-020	**67.6**	-	1	05/16/17 13:15	
FF-MUSSEL-03	K1704545-021	**79.0**	-	1	05/16/17 13:15	
FF-MUSSEL-04	K1704545-022	**80.2**	-	1	05/16/17 13:15	
FF-MUSSEL-05	K1704545-023	**75.3**	-	1	05/16/17 13:15	
REF-MUSSEL-01	K1704545-024	**77.6**	-	1	05/16/17 13:15	
REF-MUSSEL-02	K1704545-025	**75.5**	-	1	05/16/17 13:15	
REF-MUSSEL-03	K1704545-026	**81.0**	-	1	05/16/17 13:15	
REF-MUSSEL-04	K1704545-027	**78.6**	-	1	05/16/17 13:15	
REF-MUSSEL-05	K1704545-028	**82.6**	-	1	05/16/17 13:15	
REF-PRAWN-01	K1704545-029	**79.1**	-	1	05/16/17 13:15	
REF-PRAWN-02	K1704545-030	**82.3**	-	1	05/16/17 13:15	
REF-PRAWN-03	K1704545-031	**79.0**	-	1	05/16/17 13:15	
REF-CRAB-01	K1704545-032	**83.9**	-	1	05/16/17 13:15	
REF-CRAB-02	K1704545-033	**76.8**	-	1	05/16/17 13:15	
REF-CRAB-03	K1704545-034	**84.1**	-	1	05/16/17 13:15	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17 - 05/05/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/8/17
Analysis Method:	Freeze Dry	**Units:**	Percent
Prep Method:	None	**Basis:**	Wet

Total Solids

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
NF-PRAWN-01	K1704545-001	**26.4**	-	1	05/16/17 13:15	
NF-PRAWN-02	K1704545-002	**21.6**	-	1	05/16/17 13:15	
NF-PRAWN-03	K1704545-003	**21.0**	-	1	05/16/17 13:15	
NF-PRAWN-04	K1704545-004	**16.9**	-	1	05/16/17 13:15	
NF-PRAWN-05	K1704545-005	**18.1**	-	1	05/16/17 13:15	
NF-MUSSEL-01	K1704545-006	**18.6**	-	1	05/16/17 13:15	
NF-MUSSEL-02	K1704545-007	**20.6**	-	1	05/16/17 13:15	
NF-MUSSEL-03	K1704545-008	**18.9**	-	1	05/16/17 13:15	
NF-MUSSEL-04	K1704545-009	**19.8**	-	1	05/16/17 13:15	
NF-MUSSEL-05	K1704545-010	**21.1**	-	1	05/16/17 13:15	
NF-CRAB-01	K1704545-011	**21.4**	-	1	05/16/17 13:15	
NF-CRAB-02	K1704545-012	**20.9**	-	1	05/16/17 13:15	
NF-CRAB-03	K1704545-013	**20.1**	-	1	05/16/17 13:15	
MF-CRAB-01	K1704545-014	**20.8**	-	1	05/16/17 13:15	
MF-CRAB-02	K1704545-015	**13.5**	-	1	05/16/17 13:15	
MF-CRAB-03	K1704545-016	**16.3**	-	1	05/16/17 13:15	
MF-CRAB-04	K1704545-017	**21.1**	-	1	05/16/17 13:15	
MF-CRAB-05	K1704545-018	**13.9**	-	1	05/16/17 13:15	
FF-MUSSEL-01	K1704545-019	**20.4**	-	1	05/16/17 13:15	
FF-MUSSEL-02	K1704545-020	**32.4**	-	1	05/16/17 13:15	
FF-MUSSEL-03	K1704545-021	**21.0**	-	1	05/16/17 13:15	
FF-MUSSEL-04	K1704545-022	**19.8**	-	1	05/16/17 13:15	
FF-MUSSEL-05	K1704545-023	**24.7**	-	1	05/16/17 13:15	
REF-MUSSEL-01	K1704545-024	**22.4**	-	1	05/16/17 13:15	
REF-MUSSEL-02	K1704545-025	**24.5**	-	1	05/16/17 13:15	
REF-MUSSEL-03	K1704545-026	**19.0**	-	1	05/16/17 13:15	
REF-MUSSEL-04	K1704545-027	**21.4**	-	1	05/16/17 13:15	
REF-MUSSEL-05	K1704545-028	**17.4**	-	1	05/16/17 13:15	
REF-PRAWN-01	K1704545-029	**20.9**	-	1	05/16/17 13:15	
REF-PRAWN-02	K1704545-030	**17.7**	-	1	05/16/17 13:15	
REF-PRAWN-03	K1704545-031	**21.0**	-	1	05/16/17 13:15	
REF-CRAB-01	K1704545-032	**16.1**	-	1	05/16/17 13:15	
REF-CRAB-02	K1704545-033	**23.2**	-	1	05/16/17 13:15	
REF-CRAB-03	K1704545-034	**15.9**	-	1	05/16/17 13:15	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project	Skagway Tissue/1657231	**Date Collected:**	05/04/17 - 05/05/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17
Analysis Method:	Freeze Dry	**Units:**	Percent
Prep Method:	None	**Basis:**	Wet

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
NF-CRAB-02	K1704545-012DUP	-	20.9	20.8	20.9	<1	20	05/16/17
REF-CRAB-03	K1704545-034DUP	-	15.9	16.1	16.0	1	20	05/16/17

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 05/18/17 7:45:06 AM

Superset Reference:17-0000422068 rev 00

Metals

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29-05/15/17
Sample Matrix:	Animal tissue	**Date Received:**	05/08-16/17

Mercury, Total

Prep Method:	METHOD	Units:	ng/g
Analysis Method:	1631E	Basis:	Wet
Test Notes:			

Sample Name	Lab Code	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
NF-PRAWN-01	K1704545-001	2.6	5	05/19/17	05/22/17	33.4	
NF-PRAWN-02	K1704545-002	2.1	5	05/19/17	05/22/17	34.9	
NF-PRAWN-03	K1704545-003	2.1	5	05/19/17	05/22/17	23.4	
NF-PRAWN-04	K1704545-004	1.7	5	05/19/17	05/22/17	24.6	
NF-PRAWN-05	K1704545-005	1.8	5	05/19/17	05/22/17	45.7	
NF-MUSSEL-01	K1704545-006	1.9	5	05/19/17	05/22/17	17.8	
NF-MUSSEL-02	K1704545-007	2.0	5	05/19/17	05/22/17	18.9	
NF-MUSSEL-03	K1704545-008	1.9	5	05/19/17	05/22/17	15.4	
NF-MUSSEL-04	K1704545-009	2.0	5	05/19/17	05/22/17	18.9	
NF-MUSSEL-05	K1704545-010	2.1	5	05/19/17	05/22/17	21.8	
NF-CRAB-01	K1704545-011	2.1	5	05/19/17	05/22/17	97.1	
NF-CRAB-02	K1704545-012	2.1	5	05/19/17	05/22/17	73.9	
NF-CRAB-03	K1704545-013	2.0	5	05/19/17	05/22/17	73.4	
MF-CRAB-01	K1704545-014	2.1	5	05/19/17	05/22/17	95.4	
MF-CRAB-02	K1704545-015	1.4	5	05/19/17	05/22/17	29.5	
MF-CRAB-03	K1704545-016	1.6	5	05/19/17	05/22/17	69.2	
MF-CRAB-04	K1704545-017	2.1	5	05/19/17	05/22/17	73.6	
MF-CRAB-05	K1704545-018	1.4	5	05/19/17	05/22/17	31.8	
FF-MUSSEL-01	K1704545-019	2.0	5	05/19/17	05/22/17	16.9	
FF-MUSSEL-02	K1704545-020	0.6	1	05/19/17	05/22/17	15.1	
Method Blank 1	K1704545-MB1	0.1	1	05/19/17	05/22/17	ND	
Method Blank 2	K1704545-MB2	0.1	1	05/19/17	05/22/17	ND	
Method Blank 3	K1704545-MB3	0.1	1	05/19/17	05/22/17	ND	

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	04/29-05/15/17
Sample Matrix:	Animal tissue		**Date Received:**	05/08-16/17

Mercury, Total

Prep Method:	METHOD		Units:	ng/g
Analysis Method:	1631E		Basis:	Wet
Test Notes:				

Sample Name	Lab Code	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
FF-MUSSEL-03	K1704545-021	2.1	5	05/19/17	05/22/17	18.7	
FF-MUSSEL-04	K1704545-022	2.0	5	05/19/17	05/22/17	16.5	
FF-MUSSEL-05	K1704545-023	2.5	5	05/19/17	05/22/17	15.3	
REF-MUSSEL-01	K1704545-024	2.2	5	05/19/17	05/22/17	12.8	
REF-MUSSEL-02	K1704545-025	2.5	5	05/19/17	05/22/17	15.2	
REF-MUSSEL-03	K1704545-026	1.9	5	05/19/17	05/22/17	12.2	
REF-MUSSEL-04	K1704545-027	2.1	5	05/19/17	05/22/17	11.3	
REF-MUSSEL-05	K1704545-028	1.7	5	05/19/17	05/22/17	11.3	
REF-PRAWN-01	K1704545-029	2.1	5	05/19/17	05/22/17	20.4	
REF-PRAWN-02	K1704545-030	1.8	5	05/19/17	05/22/17	24.1	
REF-PRAWN-03	K1704545-031	2.1	5	05/19/17	05/22/17	29.1	
REF-CRAB-01	K1704545-032	1.6	5	05/19/17	05/22/17	62.6	
REF-CRAB-02	K1704545-033	2.3	5	05/19/17	05/22/17	71.6	
REF-CRAB-03	K1704545-034	1.6	5	05/19/17	05/22/17	122	
Method Blank 1	K1704545-MB1	0.2	1	05/19/17	05/22/17	ND	
Method Blank 2	K1704545-MB2	0.2	1	05/19/17	05/22/17	ND	
Method Blank 3	K1704545-MB3	0.2	1	05/19/17	05/22/17	ND	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/17
Sample Matrix:	Animal tissue	**Date Received:**	05/08/17
		Date Extracted:	05/19/17
		Date Analyzed:	05/22/17

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	NF-CRAB-02		Units:	ng/g
Lab Code:	K1704545-012MS,	K1704545-012MSD	Basis:	Wet
Test Notes:				

Analyte	Prep Method	Analysis Method	MRL	Spike Level MS	Spike Level DMS	Sample Result	Spike Result MS	Spike Result DMS	Percent Recovery MS	Percent Recovery DMS	ALS Acceptance Limits	Relative Percent Difference	Result Notes
Mercury	METHOD	1631E	2.1	104	105	73.9	184	182	106	103	70-130	1	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/17
Sample Matrix:	Animal tissue	**Date Received:**	05/08/17
		Date Extracted:	05/19/17
		Date Analyzed:	05/22/17

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	FF-MUSSEL-02		Units:	ng/g
Lab Code:	K1704545-020MS,	K1704545-020MSD	Basis:	Wet
Test Notes:				

Analyte	**Prep Method**	**Analysis Method**	**MRL**	**Spike Level MS**	**Spike Level DMS**	**Sample Result**	**Spike Result MS**	**Spike Result DMS**	**Percent Recovery MS**	**Percent Recovery DMS**	**ALS Acceptance Limits**	**Relative Percent Difference**	**Result Notes**
Mercury	METHOD	1631E	3.2	161	161	15.1	173	171	98	97	70-130	1	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	05/22/17

Ongoing Precision and Recovery (OPR) Sample Summary
Total Metals

Sample Name: Ongoing Precision and Recovery (Initial)

Units: ng/g
Basis: NA

Test Notes:

Analyte	**Prep Method**	**Analysis Method**	**True Value**	**Result**	**Percent Recovery**	**ALS Percent Recovery Acceptance Limits**	**Result Notes**
Mercury	METHOD	1631E	5.00	5.37	107	70-130	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	05/22/17

Ongoing Precision and Recovery (OPR) Sample Summary
Total Metals

Sample Name:	Ongoing Precision and Recovery (Final)	Units:	ng/g
		Basis:	NA

Test Notes:

Analyte	**Prep Method**	**Analysis Method**	**True Value**	**Result**	**Percent Recovery**	**ALS Percent Recovery Acceptance Limits**	**Result Notes**
Mercury	METHOD	1631E	5.00	5.00	100	70-130	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
LCS Matrix:	Animal tissue	**Date Received:**	NA
		Date Extracted:	05/19/17
		Date Analyzed:	05/22/17

Quality Control Sample (QCS) Summary
Total Metals

Sample Name:	Quality Control Sample	Units:	ng/g
Lab Code:		Basis:	Dry
Test Notes:			

Source: TORT-3

Analyte	**Prep Method**	**Analysis Method**	**True Value**	**Result**	**Percent Recovery**	**ALS Percent Recovery Acceptance Limits**	**Result Notes**
Mercury	METHOD	1631E	292	285	98	70-130	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal tissue	**Date Received:**	05/08/17
		Date Extracted:	05/19/17
		Date Analyzed:	05/22/17

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	REF-CRAB-02		Units:	ng/g
Lab Code:	K1704545-033MS,	K1704545-033MSD	Basis:	Wet
Test Notes:				

				Spike Level			Spike Result		Percent Recovery				
Analyte	**Prep Method**	**Analysis Method**	**MRL**	**MS**	**DMS**	**Sample Result**	**MS**	**DMS**	**MS**	**DMS**	**ALS Acceptance Limits**	**Relative Percent Difference**	**Result Notes**
Mercury	METHOD	1631E	2.3	116	116	71.6	196	197	107	108	70-130	<1	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal tissue	**Date Received:**	05/08/17
		Date Extracted:	05/19/17
		Date Analyzed:	05/22/17

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	REF-CRAB-03	Units:	ng/g
Lab Code:	K1704545-034MS, K1704545-034DMS	Basis:	Wet
Test Notes:			

Analyte	**Prep Method**	**Analysis Method**	**MRL**	**Spike Level MS**	**Spike Level DMS**	**Sample Result**	**Spike Result MS**	**Spike Result DMS**	**Percent Recovery MS**	**Percent Recovery DMS**	**ALS Acceptance Limits**	**Relative Percent Difference**	**Result Notes**
Mercury	METHOD	1631E	1.6	79.1	79.5	122	206	205	106	104	70-130	<1	

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	05/22/17

Ongoing Precision and Recovery (OPR) Sample Summary
Total Metals

Sample Name: Ongoing Precision and Recovery (Initial)

Units: ng/g
Basis: NA

Test Notes:

Analyte	**Prep Method**	**Analysis Method**	**True Value**	**Result**	**Percent Recovery**	**ALS Percent Recovery Acceptance Limits**	**Result Notes**
Mercury	METHOD	1631E	5.00	5.42	108	70-130	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	05/22/17

Ongoing Precision and Recovery (OPR) Sample Summary
Total Metals

Sample Name: Ongoing Precision and Recovery (Final)

Units: ng/g
Basis: NA

Test Notes:

Analyte	**Prep Method**	**Analysis Method**	**True Value**	**Result**	**Percent Recovery**	**ALS Percent Recovery Acceptance Limits**	**Result Notes**
Mercury	METHOD	1631E	5.00	5.32	106	70-130	

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
LCS Matrix:	Animal tissue	**Date Received:**	NA
		Date Extracted:	05/19/17
		Date Analyzed:	05/22/17

Quality Control Sample (QCS) Summary
Total Metals

Sample Name:	Quality Control Sample	Units:	ng/g
Lab Code:		Basis:	Dry
Test Notes:			

Source: TORT-3

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	ALS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	292	293	100	70-130	

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	05/03/17
Sample Matrix:	Animal Tissue		**Date Received:**	05/08/17 08:40
Sample Name:	NF-PRAWN-01		**Basis:**	Wet
Lab Code:	K1704545-001			

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**21.8**		mg/Kg	0.53	5	05/24/17 14:06	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.013	5	05/24/17 14:06	05/17/17	
Arsenic	6020A	**4.94**		mg/Kg	0.13	5	05/24/17 14:06	05/17/17	
Barium	6020A	**3.89**		mg/Kg	0.013	5	05/24/17 14:06	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0053	5	05/24/17 14:06	05/17/17	
Cadmium	6020A	**0.487**		mg/Kg	0.0053	5	05/24/17 14:06	05/17/17	
Calcium	6010C	**16000**		mg/Kg	5.3	10	05/24/17 16:59	05/17/17	
Chromium	6020A	**0.436**		mg/Kg	0.053	5	05/24/17 14:06	05/17/17	
Cobalt	6020A	**0.0626**		mg/Kg	0.0053	5	05/24/17 14:06	05/17/17	
Copper	6020A	**22.1**		mg/Kg	0.026	5	05/24/17 14:06	05/17/17	
Iron	6020A	**80.4**		mg/Kg	0.26	5	05/24/17 14:06	05/17/17	
Lead	6020A	**0.435**		mg/Kg	0.0053	5	05/24/17 14:06	05/17/17	
Magnesium	6010C	**883**		mg/Kg	0.13	1	05/24/17 15:54	05/17/17	
Manganese	6020A	**3.42**		mg/Kg	0.013	5	05/24/17 14:06	05/17/17	
Nickel	6020A	**0.359**		mg/Kg	0.053	5	05/24/17 14:06	05/17/17	
Potassium	6010C	**2730**		mg/Kg	11	1	05/24/17 15:54	05/17/17	
Selenium	7742	**0.472**		mg/Kg	0.026	5	05/26/17 11:28	05/17/17	
Silver	6020A	**0.443**		mg/Kg	0.0053	5	05/24/17 14:06	05/17/17	
Sodium	6010C	**3200**		mg/Kg	5.3	1	05/24/17 15:54	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0053	5	05/24/17 14:06	05/17/17	
Vanadium	6020A	**0.136**		mg/Kg	0.053	5	05/24/17 14:06	05/17/17	
Zinc	6020A	**16.7**		mg/Kg	0.13	5	05/24/17 14:06	05/17/17	

Client: Golder Associates, Inc. **Service Request:** K1704545
Project: Skagway Tissue/1657231 **Date Collected:** 05/03/17
Sample Matrix: Animal Tissue **Date Received:** 05/08/17 08:40

Sample Name: NF-PRAWN-02 **Basis:** Wet
Lab Code: K1704545-002

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**23.7**		mg/Kg	0.43	5	05/24/17 14:10	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.011	5	05/24/17 14:10	05/17/17	
Arsenic	6020A	**1.20**		mg/Kg	0.11	5	05/24/17 14:10	05/17/17	
Barium	6020A	**2.32**		mg/Kg	0.011	5	05/24/17 14:10	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0043	5	05/24/17 14:10	05/17/17	
Cadmium	6020A	**0.418**		mg/Kg	0.0043	5	05/24/17 14:10	05/17/17	
Calcium	6010C	**11800**		mg/Kg	4.3	10	05/24/17 17:02	05/17/17	
Chromium	6020A	**0.532**		mg/Kg	0.043	5	05/24/17 14:10	05/17/17	
Cobalt	6020A	**0.0481**		mg/Kg	0.0043	5	05/24/17 14:10	05/17/17	
Copper	6020A	**20.4**		mg/Kg	0.022	5	05/24/17 14:10	05/17/17	
Iron	6020A	**104**		mg/Kg	0.22	5	05/24/17 14:10	05/17/17	
Lead	6020A	**1.05**		mg/Kg	0.0043	5	05/24/17 14:10	05/17/17	
Magnesium	6010C	**557**		mg/Kg	0.11	1	05/24/17 15:56	05/17/17	
Manganese	6020A	**4.33**		mg/Kg	0.011	5	05/24/17 14:10	05/17/17	
Nickel	6020A	**0.346**		mg/Kg	0.043	5	05/24/17 14:10	05/17/17	
Potassium	6010C	**2390**		mg/Kg	8.6	1	05/24/17 15:56	05/17/17	
Selenium	7742	**0.338**		mg/Kg	0.022	5	05/26/17 11:33	05/17/17	
Silver	6020A	**0.271**		mg/Kg	0.0043	5	05/24/17 14:10	05/17/17	
Sodium	6010C	**3320**		mg/Kg	4.3	1	05/24/17 15:56	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0043	5	05/24/17 14:10	05/17/17	
Vanadium	6020A	**0.186**		mg/Kg	0.043	5	05/24/17 14:10	05/17/17	
Zinc	6020A	**14.5**		mg/Kg	0.11	5	05/24/17 14:10	05/17/17	

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	NF-PRAWN-03	**Basis:**	Wet
Lab Code:	K1704545-003		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**2.26**		mg/Kg	0.42	5	05/24/17 14:14	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.011	5	05/24/17 14:14	05/17/17	
Arsenic	6020A	**19.3**		mg/Kg	0.11	5	05/24/17 14:14	05/17/17	
Barium	6020A	**0.056**		mg/Kg	0.011	5	05/24/17 14:14	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0042	5	05/24/17 14:14	05/17/17	
Cadmium	6020A	**0.0827**		mg/Kg	0.0042	5	05/24/17 14:14	05/17/17	
Calcium	6010C	**830**		mg/Kg	0.42	1	05/24/17 16:09	05/17/17	
Chromium	6020A	**0.484**		mg/Kg	0.042	5	05/24/17 14:14	05/17/17	
Cobalt	6020A	**0.0162**		mg/Kg	0.0042	5	05/24/17 14:14	05/17/17	
Copper	6020A	**7.06**		mg/Kg	0.021	5	05/24/17 14:14	05/17/17	
Iron	6020A	**12.2**		mg/Kg	0.21	5	05/24/17 14:14	05/17/17	
Lead	6020A	**0.0260**		mg/Kg	0.0042	5	05/24/17 14:14	05/17/17	
Magnesium	6010C	**352**		mg/Kg	0.11	1	05/24/17 16:09	05/17/17	
Manganese	6020A	**0.476**		mg/Kg	0.011	5	05/24/17 14:14	05/17/17	
Nickel	6020A	**0.233**		mg/Kg	0.042	5	05/24/17 14:14	05/17/17	
Potassium	6010C	**2900**		mg/Kg	8.4	1	05/24/17 16:09	05/17/17	
Selenium	7742	**0.285**		mg/Kg	0.021	5	05/26/17 11:37	05/17/17	
Silver	6020A	**0.117**		mg/Kg	0.0042	5	05/24/17 14:14	05/17/17	
Sodium	6010C	**2620**		mg/Kg	4.2	1	05/24/17 16:09	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0042	5	05/24/17 14:14	05/17/17	
Vanadium	6020A	ND	U	mg/Kg	0.042	5	05/24/17 14:14	05/17/17	
Zinc	6020A	**13.0**		mg/Kg	0.11	5	05/24/17 14:14	05/17/17	

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	NF-PRAWN-04	**Basis:**	Wet
Lab Code:	K1704545-004		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**1.00**		mg/Kg	0.34	5	05/24/17 14:19	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.0085	5	05/24/17 14:19	05/17/17	
Arsenic	6020A	**8.65**		mg/Kg	0.085	5	05/24/17 14:19	05/17/17	
Barium	6020A	**0.0460**		mg/Kg	0.0085	5	05/24/17 14:19	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0034	5	05/24/17 14:19	05/17/17	
Cadmium	6020A	**0.0878**		mg/Kg	0.0034	5	05/24/17 14:19	05/17/17	
Calcium	6010C	**740**		mg/Kg	0.34	1	05/24/17 16:11	05/17/17	
Chromium	6020A	**0.427**		mg/Kg	0.034	5	05/24/17 14:19	05/17/17	
Cobalt	6020A	**0.0099**		mg/Kg	0.0034	5	05/24/17 14:19	05/17/17	
Copper	6020A	**8.08**		mg/Kg	0.017	5	05/24/17 14:19	05/17/17	
Iron	6020A	**22.4**		mg/Kg	0.17	5	05/24/17 14:19	05/17/17	
Lead	6020A	**0.0139**		mg/Kg	0.0034	5	05/24/17 14:19	05/17/17	
Magnesium	6010C	**318**		mg/Kg	0.085	1	05/24/17 16:11	05/17/17	
Manganese	6020A	**0.291**		mg/Kg	0.0085	5	05/24/17 14:19	05/17/17	
Nickel	6020A	**0.203**		mg/Kg	0.034	5	05/24/17 14:19	05/17/17	
Potassium	6010C	**2340**		mg/Kg	6.8	1	05/24/17 16:11	05/17/17	
Selenium	7742	**0.188**		mg/Kg	0.017	5	05/26/17 11:42	05/17/17	
Silver	6020A	**0.0869**		mg/Kg	0.0034	5	05/24/17 14:19	05/17/17	
Sodium	6010C	**2660**		mg/Kg	3.4	1	05/24/17 16:11	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0034	5	05/24/17 14:19	05/17/17	
Vanadium	6020A	ND	U	mg/Kg	0.034	5	05/24/17 14:19	05/17/17	
Zinc	6020A	**9.98**		mg/Kg	0.085	5	05/24/17 14:19	05/17/17	

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	NF-PRAWN-05	**Basis:**	Wet
Lab Code:	K1704545-005		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**0.74**	mg/Kg	0.36	5	05/24/17 14:23	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.0090	5	05/24/17 14:23	05/17/17	
Arsenic	6020A	**8.02**	mg/Kg	0.090	5	05/24/17 14:23	05/17/17	
Barium	6020A	**0.0420**	mg/Kg	0.0090	5	05/24/17 14:23	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.0036	5	05/24/17 14:23	05/17/17	
Cadmium	6020A	**0.133**	mg/Kg	0.0036	5	05/24/17 14:23	05/17/17	
Calcium	6010C	**615**	mg/Kg	0.36	1	05/24/17 16:14	05/17/17	
Chromium	6020A	**0.447**	mg/Kg	0.036	5	05/24/17 14:23	05/17/17	
Cobalt	6020A	**0.0139**	mg/Kg	0.0036	5	05/24/17 14:23	05/17/17	
Copper	6020A	**6.36**	mg/Kg	0.018	5	05/24/17 14:23	05/17/17	
Iron	6020A	**7.21**	mg/Kg	0.18	5	05/24/17 14:23	05/17/17	
Lead	6020A	**0.0081**	mg/Kg	0.0036	5	05/24/17 14:23	05/17/17	
Magnesium	6010C	**353**	mg/Kg	0.090	1	05/24/17 16:14	05/17/17	
Manganese	6020A	**0.313**	mg/Kg	0.0090	5	05/24/17 14:23	05/17/17	
Nickel	6020A	**0.202**	mg/Kg	0.036	5	05/24/17 14:23	05/17/17	
Potassium	6010C	**2710**	mg/Kg	7.2	1	05/24/17 16:14	05/17/17	
Selenium	7742	**0.214**	mg/Kg	0.018	5	05/26/17 11:51	05/17/17	
Silver	6020A	**0.118**	mg/Kg	0.0036	5	05/24/17 14:23	05/17/17	
Sodium	6010C	**2800**	mg/Kg	3.6	1	05/24/17 16:14	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.0036	5	05/24/17 14:23	05/17/17	
Vanadium	6020A	ND U	mg/Kg	0.036	5	05/24/17 14:23	05/17/17	
Zinc	6020A	**10.7**	mg/Kg	0.090	5	05/24/17 14:23	05/17/17	

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Superset Reference:

ALS Group USA, Corp.
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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	NF-MUSSEL-01	**Basis:**	Wet
Lab Code:	K1704545-006		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**12.9**	mg/Kg	0.37	5	05/24/17 14:27	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.0093	5	05/24/17 14:27	05/17/17	
Arsenic	6020A	**2.83**	mg/Kg	0.093	5	05/24/17 14:27	05/17/17	
Barium	6020A	**0.876**	mg/Kg	0.0093	5	05/24/17 14:27	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.0037	5	05/24/17 14:27	05/17/17	
Cadmium	6020A	**1.22**	mg/Kg	0.0037	5	05/24/17 14:27	05/17/17	
Calcium	6010C	**391**	mg/Kg	0.37	1	05/24/17 16:16	05/17/17	
Chromium	6020A	**1.06**	mg/Kg	0.037	5	05/24/17 14:27	05/17/17	
Cobalt	6020A	**0.102**	mg/Kg	0.0037	5	05/24/17 14:27	05/17/17	
Copper	6020A	**5.74**	mg/Kg	0.019	5	05/24/17 14:27	05/17/17	
Iron	6020A	**76.6**	mg/Kg	0.19	5	05/24/17 14:27	05/17/17	
Lead	6020A	**2.64**	mg/Kg	0.0037	5	05/24/17 14:27	05/17/17	
Magnesium	6010C	**661**	mg/Kg	0.093	1	05/24/17 16:16	05/17/17	
Manganese	6020A	**1.94**	mg/Kg	0.0093	5	05/24/17 14:27	05/17/17	
Nickel	6020A	**0.666**	mg/Kg	0.037	5	05/24/17 14:27	05/17/17	
Potassium	6010C	**2470**	mg/Kg	7.4	1	05/24/17 16:16	05/17/17	
Selenium	7742	**1.06**	mg/Kg	0.074	20	05/26/17 11:56	05/17/17	
Silver	6020A	**0.0128**	mg/Kg	0.0037	5	05/24/17 14:27	05/17/17	
Sodium	6010C	**4510**	mg/Kg	3.7	1	05/24/17 16:16	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.0037	5	05/24/17 14:27	05/17/17	
Vanadium	6020A	**0.163**	mg/Kg	0.037	5	05/24/17 14:27	05/17/17	
Zinc	6020A	**22.6**	mg/Kg	0.093	5	05/24/17 14:27	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue		**Date Received:**	05/08/17 08:40
Sample Name:	NF-MUSSEL-02		**Basis:**	Wet
Lab Code:	K1704545-007			

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**14.3**		mg/Kg	0.41	5	05/24/17 14:41	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.010	5	05/24/17 14:41	05/17/17	
Arsenic	6020A	**2.64**		mg/Kg	0.10	5	05/24/17 14:41	05/17/17	
Barium	6020A	**1.23**		mg/Kg	0.010	5	05/24/17 14:41	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0041	5	05/24/17 14:41	05/17/17	
Cadmium	6020A	**1.50**		mg/Kg	0.0041	5	05/24/17 14:41	05/17/17	
Calcium	6010C	**2880**		mg/Kg	0.41	1	05/24/17 16:19	05/17/17	
Chromium	6020A	**0.344**		mg/Kg	0.041	5	05/24/17 14:41	05/17/17	
Cobalt	6020A	**0.0969**		mg/Kg	0.0041	5	05/24/17 14:41	05/17/17	
Copper	6020A	**1.86**		mg/Kg	0.021	5	05/24/17 14:41	05/17/17	
Iron	6020A	**57.8**		mg/Kg	0.21	5	05/24/17 14:41	05/17/17	
Lead	6020A	**3.22**		mg/Kg	0.0041	5	05/24/17 14:41	05/17/17	
Magnesium	6010C	**686**		mg/Kg	0.10	1	05/24/17 16:19	05/17/17	
Manganese	6020A	**2.43**		mg/Kg	0.010	5	05/24/17 14:41	05/17/17	
Nickel	6020A	**0.316**		mg/Kg	0.041	5	05/24/17 14:41	05/17/17	
Potassium	6010C	**2520**		mg/Kg	8.2	1	05/24/17 16:19	05/17/17	
Selenium	7742	**1.19**		mg/Kg	0.082	20	05/26/17 12:01	05/17/17	
Silver	6020A	**0.0139**		mg/Kg	0.0041	5	05/24/17 14:41	05/17/17	
Sodium	6010C	**4520**		mg/Kg	4.1	1	05/24/17 16:19	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0041	5	05/24/17 14:41	05/17/17	
Vanadium	6020A	**0.196**		mg/Kg	0.041	5	05/24/17 14:41	05/17/17	
Zinc	6020A	**20.6**		mg/Kg	0.10	5	05/24/17 14:41	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	NF-MUSSEL-03	**Basis:**	Wet
Lab Code:	K1704545-008		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**12.0**		mg/Kg	0.38	5	05/24/17 14:45	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.0095	5	05/24/17 14:45	05/17/17	
Arsenic	6020A	**2.78**		mg/Kg	0.095	5	05/24/17 14:45	05/17/17	
Barium	6020A	**0.955**		mg/Kg	0.0095	5	05/24/17 14:45	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0038	5	05/24/17 14:45	05/17/17	
Cadmium	6020A	**1.25**		mg/Kg	0.0038	5	05/24/17 14:45	05/17/17	
Calcium	6010C	**3390**		mg/Kg	0.38	1	05/24/17 16:21	05/17/17	
Chromium	6020A	**0.221**		mg/Kg	0.038	5	05/24/17 14:45	05/17/17	
Cobalt	6020A	**0.0896**		mg/Kg	0.0038	5	05/24/17 14:45	05/17/17	
Copper	6020A	**1.69**		mg/Kg	0.019	5	05/24/17 14:45	05/17/17	
Iron	6020A	**46.8**		mg/Kg	0.19	5	05/24/17 14:45	05/17/17	
Lead	6020A	**2.03**		mg/Kg	0.0038	5	05/24/17 14:45	05/17/17	
Magnesium	6010C	**680**		mg/Kg	0.095	1	05/24/17 16:21	05/17/17	
Manganese	6020A	**2.46**		mg/Kg	0.0095	5	05/24/17 14:45	05/17/17	
Nickel	6020A	**0.275**		mg/Kg	0.038	5	05/24/17 14:45	05/17/17	
Potassium	6010C	**2460**		mg/Kg	7.6	1	05/24/17 16:21	05/17/17	
Selenium	7742	**1.07**		mg/Kg	0.076	20	05/26/17 12:05	05/17/17	
Silver	6020A	**0.0141**		mg/Kg	0.0038	5	05/24/17 14:45	05/17/17	
Sodium	6010C	**4660**		mg/Kg	3.8	1	05/24/17 16:21	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0038	5	05/24/17 14:45	05/17/17	
Vanadium	6020A	**0.173**		mg/Kg	0.038	5	05/24/17 14:45	05/17/17	
Zinc	6020A	**18.4**		mg/Kg	0.095	5	05/24/17 14:45	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	NF-MUSSEL-04	**Basis:**	Wet
Lab Code:	K1704545-009		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**15.3**		mg/Kg	0.40	5	05/24/17 14:49	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.0099	5	05/24/17 14:49	05/17/17	
Arsenic	6020A	**2.55**		mg/Kg	0.099	5	05/24/17 14:49	05/17/17	
Barium	6020A	**1.20**		mg/Kg	0.0099	5	05/24/17 14:49	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0040	5	05/24/17 14:49	05/17/17	
Cadmium	6020A	**1.43**		mg/Kg	0.0040	5	05/24/17 14:49	05/17/17	
Calcium	6010C	**851**		mg/Kg	0.40	1	05/24/17 16:24	05/17/17	
Chromium	6020A	**0.525**		mg/Kg	0.040	5	05/24/17 14:49	05/17/17	
Cobalt	6020A	**0.103**		mg/Kg	0.0040	5	05/24/17 14:49	05/17/17	
Copper	6020A	**1.87**		mg/Kg	0.020	5	05/24/17 14:49	05/17/17	
Iron	6020A	**57.7**		mg/Kg	0.20	5	05/24/17 14:49	05/17/17	
Lead	6020A	**3.23**		mg/Kg	0.0040	5	05/24/17 14:49	05/17/17	
Magnesium	6010C	**662**		mg/Kg	0.099	1	05/24/17 16:24	05/17/17	
Manganese	6020A	**2.09**		mg/Kg	0.0099	5	05/24/17 14:49	05/17/17	
Nickel	6020A	**0.410**		mg/Kg	0.040	5	05/24/17 14:49	05/17/17	
Potassium	6010C	**2520**		mg/Kg	7.9	1	05/24/17 16:24	05/17/17	
Selenium	7742	**1.13**		mg/Kg	0.079	20	05/26/17 12:10	05/17/17	
Silver	6020A	**0.0151**		mg/Kg	0.0040	5	05/24/17 14:49	05/17/17	
Sodium	6010C	**4300**		mg/Kg	4.0	1	05/24/17 16:24	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0040	5	05/24/17 14:49	05/17/17	
Vanadium	6020A	**0.178**		mg/Kg	0.040	5	05/24/17 14:49	05/17/17	
Zinc	6020A	**24.1**		mg/Kg	0.099	5	05/24/17 14:49	05/17/17	

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Superset Reference:

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue		**Date Received:**	05/08/17 08:40
Sample Name:	NF-MUSSEL-05		**Basis:**	Wet
Lab Code:	K1704545-010			

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**18.1**	mg/Kg	0.42	5	05/24/17 14:54	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.011	5	05/24/17 14:54	05/17/17	
Arsenic	6020A	**2.90**	mg/Kg	0.11	5	05/24/17 14:54	05/17/17	
Barium	6020A	**1.25**	mg/Kg	0.011	5	05/24/17 14:54	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.0042	5	05/24/17 14:54	05/17/17	
Cadmium	6020A	**1.56**	mg/Kg	0.0042	5	05/24/17 14:54	05/17/17	
Calcium	6010C	**670**	mg/Kg	0.42	1	05/24/17 16:27	05/17/17	
Chromium	6020A	**0.392**	mg/Kg	0.042	5	05/24/17 14:54	05/17/17	
Cobalt	6020A	**0.119**	mg/Kg	0.0042	5	05/24/17 14:54	05/17/17	
Copper	6020A	**1.91**	mg/Kg	0.021	5	05/24/17 14:54	05/17/17	
Iron	6020A	**64.9**	mg/Kg	0.21	5	05/24/17 14:54	05/17/17	
Lead	6020A	**4.07**	mg/Kg	0.0042	5	05/24/17 14:54	05/17/17	
Magnesium	6010C	**630**	mg/Kg	0.11	1	05/24/17 16:27	05/17/17	
Manganese	6020A	**2.18**	mg/Kg	0.011	5	05/24/17 14:54	05/17/17	
Nickel	6020A	**0.409**	mg/Kg	0.042	5	05/24/17 14:54	05/17/17	
Potassium	6010C	**2720**	mg/Kg	8.4	1	05/24/17 16:27	05/17/17	
Selenium	7742	**1.72**	mg/Kg	0.084	20	05/26/17 12:19	05/17/17	
Silver	6020A	**0.0151**	mg/Kg	0.0042	5	05/24/17 14:54	05/17/17	
Sodium	6010C	**4030**	mg/Kg	4.2	1	05/24/17 16:27	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.0042	5	05/24/17 14:54	05/17/17	
Vanadium	6020A	**0.253**	mg/Kg	0.042	5	05/24/17 14:54	05/17/17	
Zinc	6020A	**23.7**	mg/Kg	0.11	5	05/24/17 14:54	05/17/17	

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/01/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	NF-CRAB-01	**Basis:**	Wet
Lab Code:	K1704545-011		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**6.96**		mg/Kg	0.43	5	05/24/17 14:58	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.011	5	05/24/17 14:58	05/17/17	
Arsenic	6020A	**3.56**		mg/Kg	0.11	5	05/24/17 14:58	05/17/17	
Barium	6020A	**1.22**		mg/Kg	0.011	5	05/24/17 14:58	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0043	5	05/24/17 14:58	05/17/17	
Cadmium	6020A	**0.0483**		mg/Kg	0.0043	5	05/24/17 14:58	05/17/17	
Calcium	6010C	**8040**		mg/Kg	0.43	1	05/24/17 16:29	05/17/17	
Chromium	6020A	**0.195**		mg/Kg	0.043	5	05/24/17 14:58	05/17/17	
Cobalt	6020A	**0.0604**		mg/Kg	0.0043	5	05/24/17 14:58	05/17/17	
Copper	6020A	**3.97**		mg/Kg	0.021	5	05/24/17 14:58	05/17/17	
Iron	6020A	**15.8**		mg/Kg	0.21	5	05/24/17 14:58	05/17/17	
Lead	6020A	**0.245**		mg/Kg	0.0043	5	05/24/17 14:58	05/17/17	
Magnesium	6010C	**621**		mg/Kg	0.11	1	05/24/17 16:29	05/17/17	
Manganese	6020A	**1.26**		mg/Kg	0.011	5	05/24/17 14:58	05/17/17	
Nickel	6020A	**0.108**		mg/Kg	0.043	5	05/24/17 14:58	05/17/17	
Potassium	6010C	**3020**		mg/Kg	8.6	1	05/24/17 16:29	05/17/17	
Selenium	7742	**0.283**		mg/Kg	0.021	5	05/26/17 12:24	05/17/17	
Silver	6020A	**0.0632**		mg/Kg	0.0043	5	05/24/17 14:58	05/17/17	
Sodium	6010C	**3950**		mg/Kg	4.3	1	05/24/17 16:29	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0043	5	05/24/17 14:58	05/17/17	
Vanadium	6020A	ND	U	mg/Kg	0.043	5	05/24/17 14:58	05/17/17	
Zinc	6020A	**36.3**		mg/Kg	0.11	5	05/24/17 14:58	05/17/17	

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	NF-CRAB-02	**Basis:**	Wet
Lab Code:	K1704545-012		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**7.10**		mg/Kg	0.42	5	05/24/17 15:02	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.010	5	05/24/17 15:02	05/17/17	
Arsenic	6020A	**3.97**		mg/Kg	0.10	5	05/24/17 15:02	05/17/17	
Barium	6020A	**0.173**		mg/Kg	0.010	5	05/24/17 15:02	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0042	5	05/24/17 15:02	05/17/17	
Cadmium	6020A	**0.111**		mg/Kg	0.0042	5	05/24/17 15:02	05/17/17	
Calcium	6010C	**939**		mg/Kg	0.42	1	05/24/17 15:46	05/17/17	
Chromium	6020A	**0.144**		mg/Kg	0.042	5	05/24/17 15:02	05/17/17	
Cobalt	6020A	**0.0774**		mg/Kg	0.0042	5	05/24/17 15:02	05/17/17	
Copper	6020A	**8.26**		mg/Kg	0.021	5	05/24/17 15:02	05/17/17	
Iron	6020A	**32.7**		mg/Kg	0.21	5	05/24/17 15:02	05/17/17	
Lead	6020A	**0.174**		mg/Kg	0.0042	5	05/24/17 15:02	05/17/17	
Magnesium	6010C	**400**		mg/Kg	0.10	1	05/24/17 15:46	05/17/17	
Manganese	6020A	**0.501**		mg/Kg	0.010	5	05/24/17 15:02	05/17/17	
Nickel	6020A	**0.096**		mg/Kg	0.042	5	05/24/17 15:02	05/17/17	
Potassium	6010C	**3140**		mg/Kg	8.3	1	05/24/17 15:46	05/17/17	
Selenium	7742	**0.605**		mg/Kg	0.042	10	05/26/17 11:10	05/17/17	
Silver	6020A	**0.117**		mg/Kg	0.0042	5	05/24/17 15:02	05/17/17	
Sodium	6010C	**3910**		mg/Kg	4.2	1	05/24/17 15:46	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0042	5	05/24/17 15:02	05/17/17	
Vanadium	6020A	ND	U	mg/Kg	0.042	5	05/24/17 15:02	05/17/17	
Zinc	6020A	**46.0**		mg/Kg	0.10	5	05/24/17 15:02	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	05/04/17
Sample Matrix:	Animal Tissue		**Date Received:**	05/08/17 08:40
Sample Name:	NF-CRAB-03		**Basis:**	Wet
Lab Code:	K1704545-013			

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**10.2**	mg/Kg	0.40	5	05/24/17 15:37	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.010	5	05/24/17 15:37	05/17/17	
Arsenic	6020A	**3.83**	mg/Kg	0.10	5	05/24/17 15:37	05/17/17	
Barium	6020A	**0.263**	mg/Kg	0.010	5	05/24/17 15:37	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.0040	5	05/24/17 15:37	05/17/17	
Cadmium	6020A	**0.0571**	mg/Kg	0.0040	5	05/24/17 15:37	05/17/17	
Calcium	6010C	**1150**	mg/Kg	0.40	1	05/24/17 16:32	05/17/17	
Chromium	6020A	**0.270**	mg/Kg	0.040	5	05/24/17 15:37	05/17/17	
Cobalt	6020A	**0.0862**	mg/Kg	0.0040	5	05/24/17 15:37	05/17/17	
Copper	6020A	**11.8**	mg/Kg	0.020	5	05/24/17 15:37	05/17/17	
Iron	6020A	**36.6**	mg/Kg	0.20	5	05/24/17 15:37	05/17/17	
Lead	6020A	**0.241**	mg/Kg	0.0040	5	05/24/17 15:37	05/17/17	
Magnesium	6010C	**426**	mg/Kg	0.10	1	05/24/17 16:32	05/17/17	
Manganese	6020A	**0.786**	mg/Kg	0.010	5	05/24/17 15:37	05/17/17	
Nickel	6020A	**0.150**	mg/Kg	0.040	5	05/24/17 15:37	05/17/17	
Potassium	6010C	**2990**	mg/Kg	8.0	1	05/24/17 16:32	05/17/17	
Selenium	7742	**0.659**	mg/Kg	0.020	5	05/26/17 12:29	05/17/17	
Silver	6020A	**0.119**	mg/Kg	0.0040	5	05/24/17 15:37	05/17/17	
Sodium	6010C	**4060**	mg/Kg	4.0	1	05/24/17 16:32	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.0040	5	05/24/17 15:37	05/17/17	
Vanadium	6020A	**0.045**	mg/Kg	0.040	5	05/24/17 15:37	05/17/17	
Zinc	6020A	**47.2**	mg/Kg	0.10	5	05/24/17 15:37	05/17/17	

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Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal Tissue

Service Request: K1704545
Date Collected: 05/03/17
Date Received: 05/08/17 08:40

Sample Name: MF-CRAB-01
Lab Code: K1704545-014

Basis: Wet

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**7.52**		mg/Kg	0.42	5	05/24/17 15:42	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.010	5	05/24/17 15:42	05/17/17	
Arsenic	6020A	**4.35**		mg/Kg	0.10	5	05/24/17 15:42	05/17/17	
Barium	6020A	**0.252**		mg/Kg	0.010	5	05/24/17 15:42	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0042	5	05/24/17 15:42	05/17/17	
Cadmium	6020A	**0.0887**		mg/Kg	0.0042	5	05/24/17 15:42	05/17/17	
Calcium	6010C	**1450**		mg/Kg	0.42	1	05/24/17 16:42	05/17/17	
Chromium	6020A	**0.087**		mg/Kg	0.042	5	05/24/17 15:42	05/17/17	
Cobalt	6020A	**0.0702**		mg/Kg	0.0042	5	05/24/17 15:42	05/17/17	
Copper	6020A	**6.04**		mg/Kg	0.021	5	05/24/17 15:42	05/17/17	
Iron	6020A	**17.2**		mg/Kg	0.21	5	05/24/17 15:42	05/17/17	
Lead	6020A	**0.282**		mg/Kg	0.0042	5	05/24/17 15:42	05/17/17	
Magnesium	6010C	**426**		mg/Kg	0.10	1	05/24/17 16:42	05/17/17	
Manganese	6020A	**0.684**		mg/Kg	0.010	5	05/24/17 15:42	05/17/17	
Nickel	6020A	**0.067**		mg/Kg	0.042	5	05/24/17 15:42	05/17/17	
Potassium	6010C	**3320**		mg/Kg	8.3	1	05/24/17 16:42	05/17/17	
Selenium	7742	**0.703**		mg/Kg	0.021	5	05/26/17 12:33	05/17/17	
Silver	6020A	**0.0792**		mg/Kg	0.0042	5	05/24/17 15:42	05/17/17	
Sodium	6010C	**4050**		mg/Kg	4.2	1	05/24/17 16:42	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0042	5	05/24/17 15:42	05/17/17	
Vanadium	6020A	ND	U	mg/Kg	0.042	5	05/24/17 15:42	05/17/17	
Zinc	6020A	**44.0**		mg/Kg	0.10	5	05/24/17 15:42	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	MF-CRAB-02	**Basis:**	Wet
Lab Code:	K1704545-015		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**5.68**		mg/Kg	0.27	5	05/24/17 15:46	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.0067	5	05/24/17 15:46	05/17/17	
Arsenic	6020A	**1.83**		mg/Kg	0.067	5	05/24/17 15:46	05/17/17	
Barium	6020A	**0.106**		mg/Kg	0.0067	5	05/24/17 15:46	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0027	5	05/24/17 15:46	05/17/17	
Cadmium	6020A	**0.119**		mg/Kg	0.0027	5	05/24/17 15:46	05/17/17	
Calcium	6010C	**1210**		mg/Kg	0.27	1	05/24/17 16:44	05/17/17	
Chromium	6020A	**0.839**		mg/Kg	0.027	5	05/24/17 15:46	05/17/17	
Cobalt	6020A	**0.0697**		mg/Kg	0.0027	5	05/24/17 15:46	05/17/17	
Copper	6020A	**6.69**		mg/Kg	0.013	5	05/24/17 15:46	05/17/17	
Iron	6020A	**17.4**		mg/Kg	0.13	5	05/24/17 15:46	05/17/17	
Lead	6020A	**0.0339**		mg/Kg	0.0027	5	05/24/17 15:46	05/17/17	
Magnesium	6010C	**368**		mg/Kg	0.067	1	05/24/17 16:44	05/17/17	
Manganese	6020A	**0.330**		mg/Kg	0.0067	5	05/24/17 15:46	05/17/17	
Nickel	6020A	**0.387**		mg/Kg	0.027	5	05/24/17 15:46	05/17/17	
Potassium	6010C	**1980**		mg/Kg	5.4	1	05/24/17 16:44	05/17/17	
Selenium	7742	**0.252**		mg/Kg	0.013	5	05/26/17 12:38	05/17/17	
Silver	6020A	**0.119**		mg/Kg	0.0027	5	05/24/17 15:46	05/17/17	
Sodium	6010C	**6880**		mg/Kg	27	10	05/30/17 09:05	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0027	5	05/24/17 15:46	05/17/17	
Vanadium	6020A	ND	U	mg/Kg	0.027	5	05/24/17 15:46	05/17/17	
Zinc	6020A	**23.7**		mg/Kg	0.067	5	05/24/17 15:46	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	MF-CRAB-03	**Basis:**	Wet
Lab Code:	K1704545-016		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**5.90**		mg/Kg	0.33	5	05/24/17 15:50	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.0082	5	05/24/17 15:50	05/17/17	
Arsenic	6020A	**3.14**		mg/Kg	0.082	5	05/24/17 15:50	05/17/17	
Barium	6020A	**0.139**		mg/Kg	0.0082	5	05/24/17 15:50	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0033	5	05/24/17 15:50	05/17/17	
Cadmium	6020A	**0.194**		mg/Kg	0.0033	5	05/24/17 15:50	05/17/17	
Calcium	6010C	**1100**		mg/Kg	0.33	1	05/24/17 16:47	05/17/17	
Chromium	6020A	**0.202**		mg/Kg	0.033	5	05/24/17 15:50	05/17/17	
Cobalt	6020A	**0.0716**		mg/Kg	0.0033	5	05/24/17 15:50	05/17/17	
Copper	6020A	**6.97**		mg/Kg	0.016	5	05/24/17 15:50	05/17/17	
Iron	6020A	**15.5**		mg/Kg	0.16	5	05/24/17 15:50	05/17/17	
Lead	6020A	**0.0450**		mg/Kg	0.0033	5	05/24/17 15:50	05/17/17	
Magnesium	6010C	**319**		mg/Kg	0.082	1	05/24/17 16:47	05/17/17	
Manganese	6020A	**0.413**		mg/Kg	0.0082	5	05/24/17 15:50	05/17/17	
Nickel	6020A	**0.125**		mg/Kg	0.033	5	05/24/17 15:50	05/17/17	
Potassium	6010C	**2770**		mg/Kg	6.5	1	05/24/17 16:47	05/17/17	
Selenium	7742	**0.634**		mg/Kg	0.033	10	05/26/17 14:56	05/17/17	
Silver	6020A	**0.0842**		mg/Kg	0.0033	5	05/24/17 15:50	05/17/17	
Sodium	6010C	**5190**		mg/Kg	3.3	1	05/24/17 16:47	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0033	5	05/24/17 15:50	05/17/17	
Vanadium	6020A	**0.034**		mg/Kg	0.033	5	05/24/17 15:50	05/17/17	
Zinc	6020A	**31.4**		mg/Kg	0.082	5	05/24/17 15:50	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	MF-CRAB-04	**Basis:**	Wet
Lab Code:	K1704545-017		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**8.60**		mg/Kg	0.42	5	05/24/17 15:55	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.011	5	05/24/17 15:55	05/17/17	
Arsenic	6020A	**3.13**		mg/Kg	0.11	5	05/24/17 15:55	05/17/17	
Barium	6020A	**0.376**		mg/Kg	0.011	5	05/24/17 15:55	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0042	5	05/24/17 15:55	05/17/17	
Cadmium	6020A	**0.0312**		mg/Kg	0.0042	5	05/24/17 15:55	05/17/17	
Calcium	6010C	**2350**		mg/Kg	0.42	1	05/24/17 16:49	05/17/17	
Chromium	6020A	**0.318**		mg/Kg	0.042	5	05/24/17 15:55	05/17/17	
Cobalt	6020A	**0.0844**		mg/Kg	0.0042	5	05/24/17 15:55	05/17/17	
Copper	6020A	**8.42**		mg/Kg	0.021	5	05/24/17 15:55	05/17/17	
Iron	6020A	**21.6**		mg/Kg	0.21	5	05/24/17 15:55	05/17/17	
Lead	6020A	**0.0231**		mg/Kg	0.0042	5	05/24/17 15:55	05/17/17	
Magnesium	6010C	**431**		mg/Kg	0.11	1	05/24/17 16:49	05/17/17	
Manganese	6020A	**0.755**		mg/Kg	0.011	5	05/24/17 15:55	05/17/17	
Nickel	6020A	**0.165**		mg/Kg	0.042	5	05/24/17 15:55	05/17/17	
Potassium	6010C	**3170**		mg/Kg	8.4	1	05/24/17 16:49	05/17/17	
Selenium	7742	**0.582**		mg/Kg	0.021	5	05/26/17 12:52	05/17/17	
Silver	6020A	**0.120**		mg/Kg	0.0042	5	05/24/17 15:55	05/17/17	
Sodium	6010C	**4280**		mg/Kg	4.2	1	05/24/17 16:49	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0042	5	05/24/17 15:55	05/17/17	
Vanadium	6020A	ND	U	mg/Kg	0.042	5	05/24/17 15:55	05/17/17	
Zinc	6020A	**44.5**		mg/Kg	0.11	5	05/24/17 15:55	05/17/17	

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Superset Reference:

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	MF-CRAB-05	**Basis:**	Wet
Lab Code:	K1704545-018		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**2.91**		mg/Kg	0.28	5	05/24/17 15:59	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.0069	5	05/24/17 15:59	05/17/17	
Arsenic	6020A	**1.87**		mg/Kg	0.069	5	05/24/17 15:59	05/17/17	
Barium	6020A	**0.0912**		mg/Kg	0.0069	5	05/24/17 15:59	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0028	5	05/24/17 15:59	05/17/17	
Cadmium	6020A	**0.0187**		mg/Kg	0.0028	5	05/24/17 15:59	05/17/17	
Calcium	6010C	**1270**		mg/Kg	0.28	1	05/24/17 16:52	05/17/17	
Chromium	6020A	**0.105**		mg/Kg	0.028	5	05/24/17 15:59	05/17/17	
Cobalt	6020A	**0.0832**		mg/Kg	0.0028	5	05/24/17 15:59	05/17/17	
Copper	6020A	**6.45**		mg/Kg	0.014	5	05/24/17 15:59	05/17/17	
Iron	6020A	**7.13**		mg/Kg	0.14	5	05/24/17 15:59	05/17/17	
Lead	6020A	**0.0441**		mg/Kg	0.0028	5	05/24/17 15:59	05/17/17	
Magnesium	6010C	**327**		mg/Kg	0.069	1	05/24/17 16:52	05/17/17	
Manganese	6020A	**0.212**		mg/Kg	0.0069	5	05/24/17 15:59	05/17/17	
Nickel	6020A	**0.060**		mg/Kg	0.028	5	05/24/17 15:59	05/17/17	
Potassium	6010C	**2080**		mg/Kg	5.5	1	05/24/17 16:52	05/17/17	
Selenium	7742	**0.388**		mg/Kg	0.014	5	05/26/17 12:56	05/17/17	
Silver	6020A	**0.114**		mg/Kg	0.0028	5	05/24/17 15:59	05/17/17	
Sodium	6010C	**6550**		mg/Kg	28	10	05/30/17 09:07	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0028	5	05/24/17 15:59	05/17/17	
Vanadium	6020A	ND	U	mg/Kg	0.028	5	05/24/17 15:59	05/17/17	
Zinc	6020A	**24.4**		mg/Kg	0.069	5	05/24/17 15:59	05/17/17	

Analytical Report

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue		**Date Received:**	05/08/17 08:40
Sample Name:	FF-MUSSEL-01		**Basis:**	Wet
Lab Code:	K1704545-019			

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**19.0**		mg/Kg	0.41	5	05/24/17 16:03	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.010	5	05/24/17 16:03	05/17/17	
Arsenic	6020A	**2.69**		mg/Kg	0.10	5	05/24/17 16:03	05/17/17	
Barium	6020A	**2.96**		mg/Kg	0.010	5	05/24/17 16:03	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0041	5	05/24/17 16:03	05/17/17	
Cadmium	6020A	**1.34**		mg/Kg	0.0041	5	05/24/17 16:03	05/17/17	
Calcium	6010C	**1620**		mg/Kg	0.41	1	05/24/17 16:54	05/17/17	
Chromium	6020A	**0.376**		mg/Kg	0.041	5	05/24/17 16:03	05/17/17	
Cobalt	6020A	**0.106**		mg/Kg	0.0041	5	05/24/17 16:03	05/17/17	
Copper	6020A	**1.82**		mg/Kg	0.020	5	05/24/17 16:03	05/17/17	
Iron	6020A	**51.4**		mg/Kg	0.20	5	05/24/17 16:03	05/17/17	
Lead	6020A	**0.243**		mg/Kg	0.0041	5	05/24/17 16:03	05/17/17	
Magnesium	6010C	**629**		mg/Kg	0.10	1	05/24/17 16:54	05/17/17	
Manganese	6020A	**4.71**		mg/Kg	0.010	5	05/24/17 16:03	05/17/17	
Nickel	6020A	**0.403**		mg/Kg	0.041	5	05/24/17 16:03	05/17/17	
Potassium	6010C	**2620**		mg/Kg	8.1	1	05/24/17 16:54	05/17/17	
Selenium	7742	**1.10**		mg/Kg	0.081	20	05/26/17 13:01	05/17/17	
Silver	6020A	**0.0268**		mg/Kg	0.0041	5	05/24/17 16:03	05/17/17	
Sodium	6010C	**4200**		mg/Kg	4.1	1	05/24/17 16:54	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0041	5	05/24/17 16:03	05/17/17	
Vanadium	6020A	**0.171**		mg/Kg	0.041	5	05/24/17 16:03	05/17/17	
Zinc	6020A	**22.9**		mg/Kg	0.10	5	05/24/17 16:03	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	FF-MUSSEL-02	**Basis:**	Wet
Lab Code:	K1704545-020		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**16.2**		mg/Kg	0.65	5	05/24/17 16:08	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.016	5	05/24/17 16:08	05/17/17	
Arsenic	6020A	**2.14**		mg/Kg	0.16	5	05/24/17 16:08	05/17/17	
Barium	6020A	**4.77**		mg/Kg	0.016	5	05/24/17 16:08	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0065	5	05/24/17 16:08	05/17/17	
Cadmium	6020A	**0.938**		mg/Kg	0.0065	5	05/24/17 16:08	05/17/17	
Calcium	6010C	**62500**		mg/Kg	6.5	10	05/24/17 17:04	05/17/17	
Chromium	6020A	**0.478**		mg/Kg	0.065	5	05/24/17 16:08	05/17/17	
Cobalt	6020A	**0.0827**		mg/Kg	0.0065	5	05/24/17 16:08	05/17/17	
Copper	6020A	**1.35**		mg/Kg	0.032	5	05/24/17 16:08	05/17/17	
Iron	6020A	**47.1**		mg/Kg	0.32	5	05/24/17 16:08	05/17/17	
Lead	6020A	**0.211**		mg/Kg	0.0065	5	05/24/17 16:08	05/17/17	
Magnesium	6010C	**630**		mg/Kg	0.16	1	05/24/17 16:57	05/17/17	
Manganese	6020A	**3.83**		mg/Kg	0.016	5	05/24/17 16:08	05/17/17	
Nickel	6020A	**0.361**		mg/Kg	0.065	5	05/24/17 16:08	05/17/17	
Potassium	6010C	**2160**		mg/Kg	13	1	05/24/17 16:57	05/17/17	
Selenium	7742	**0.943**		mg/Kg	0.032	5	05/26/17 13:06	05/17/17	
Silver	6020A	**0.0159**		mg/Kg	0.0065	5	05/24/17 16:08	05/17/17	
Sodium	6010C	**4310**		mg/Kg	6.5	1	05/24/17 16:57	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0065	5	05/24/17 16:08	05/17/17	
Vanadium	6020A	**0.256**		mg/Kg	0.065	5	05/24/17 16:08	05/17/17	
Zinc	6020A	**14.9**		mg/Kg	0.16	5	05/24/17 16:08	05/17/17	

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Superset Reference:

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	FF-MUSSEL-03	**Basis:**	Wet
Lab Code:	K1704545-021		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**31.9**	mg/Kg	0.42	5	05/24/17 16:38	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.011	5	05/24/17 16:38	05/17/17	
Arsenic	6020A	**2.67**	mg/Kg	0.11	5	05/24/17 16:38	05/17/17	
Barium	6020A	**2.09**	mg/Kg	0.011	5	05/24/17 16:38	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.0042	5	05/24/17 16:38	05/17/17	
Cadmium	6020A	**1.56**	mg/Kg	0.0042	5	05/24/17 16:38	05/17/17	
Calcium	6010C	**7110**	mg/Kg	0.42	1	05/24/17 14:27	05/17/17	
Chromium	6020A	**0.366**	mg/Kg	0.042	5	05/24/17 16:38	05/17/17	
Cobalt	6020A	**0.149**	mg/Kg	0.0042	5	05/24/17 16:38	05/17/17	
Copper	6020A	**1.87**	mg/Kg	0.021	5	05/24/17 16:38	05/17/17	
Iron	6020A	**72.4**	mg/Kg	0.21	5	05/24/17 16:38	05/17/17	
Lead	6020A	**0.406**	mg/Kg	0.0042	5	05/24/17 16:38	05/17/17	
Magnesium	6010C	**664**	mg/Kg	0.11	1	05/24/17 14:27	05/17/17	
Manganese	6020A	**6.67**	mg/Kg	0.011	5	05/24/17 16:38	05/17/17	
Nickel	6020A	**0.591**	mg/Kg	0.042	5	05/24/17 16:38	05/17/17	
Potassium	6010C	**2500**	mg/Kg	8.4	1	05/24/17 14:27	05/17/17	
Selenium	7742	**1.25**	mg/Kg	0.084	20	05/26/17 13:47	05/17/17	
Silver	6020A	**0.0267**	mg/Kg	0.0042	5	05/24/17 16:38	05/17/17	
Sodium	6010C	**4360**	mg/Kg	4.2	1	05/24/17 14:27	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.0042	5	05/24/17 16:38	05/17/17	
Vanadium	6020A	**0.915**	mg/Kg	0.042	5	05/24/17 16:38	05/17/17	
Zinc	6020A	**21.7**	mg/Kg	0.11	5	05/24/17 16:38	05/17/17	

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	FF-MUSSEL-04	**Basis:**	Wet
Lab Code:	K1704545-022		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**26.2**		mg/Kg	0.40	5	05/24/17 16:42	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.0099	5	05/24/17 16:42	05/17/17	
Arsenic	6020A	**2.64**		mg/Kg	0.099	5	05/24/17 16:42	05/17/17	
Barium	6020A	**1.33**		mg/Kg	0.0099	5	05/24/17 16:42	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0040	5	05/24/17 16:42	05/17/17	
Cadmium	6020A	**1.54**		mg/Kg	0.0040	5	05/24/17 16:42	05/17/17	
Calcium	6010C	**634**		mg/Kg	0.40	1	05/24/17 14:30	05/17/17	
Chromium	6020A	**0.435**		mg/Kg	0.040	5	05/24/17 16:42	05/17/17	
Cobalt	6020A	**0.110**		mg/Kg	0.0040	5	05/24/17 16:42	05/17/17	
Copper	6020A	**1.64**		mg/Kg	0.020	5	05/24/17 16:42	05/17/17	
Iron	6020A	**66.1**		mg/Kg	0.20	5	05/24/17 16:42	05/17/17	
Lead	6020A	**0.326**		mg/Kg	0.0040	5	05/24/17 16:42	05/17/17	
Magnesium	6010C	**727**		mg/Kg	0.099	1	05/24/17 14:30	05/17/17	
Manganese	6020A	**2.57**		mg/Kg	0.0099	5	05/24/17 16:42	05/17/17	
Nickel	6020A	**0.361**		mg/Kg	0.040	5	05/24/17 16:42	05/17/17	
Potassium	6010C	**2660**		mg/Kg	7.9	1	05/24/17 14:30	05/17/17	
Selenium	7742	**0.992**		mg/Kg	0.079	20	05/26/17 13:52	05/17/17	
Silver	6020A	**0.0265**		mg/Kg	0.0040	5	05/24/17 16:42	05/17/17	
Sodium	6010C	**4710**		mg/Kg	4.0	1	05/24/17 14:30	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0040	5	05/24/17 16:42	05/17/17	
Vanadium	6020A	**0.307**		mg/Kg	0.040	5	05/24/17 16:42	05/17/17	
Zinc	6020A	**18.4**		mg/Kg	0.099	5	05/24/17 16:42	05/17/17	

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Analytical Report

Client: Golder Associates, Inc. **Service Request:** K1704545
Project: Skagway Tissue/1657231 **Date Collected:** 04/29/17
Sample Matrix: Animal Tissue **Date Received:** 05/08/17 08:40

Sample Name: FF-MUSSEL-05 **Basis:** Wet
Lab Code: K1704545-023

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**16.6**		mg/Kg	0.49	5	05/24/17 16:47	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.012	5	05/24/17 16:47	05/17/17	
Arsenic	6020A	**2.47**		mg/Kg	0.12	5	05/24/17 16:47	05/17/17	
Barium	6020A	**1.87**		mg/Kg	0.012	5	05/24/17 16:47	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0049	5	05/24/17 16:47	05/17/17	
Cadmium	6020A	**1.32**		mg/Kg	0.0049	5	05/24/17 16:47	05/17/17	
Calcium	6010C	**22400**		mg/Kg	4.9	10	05/24/17 15:34	05/17/17	
Chromium	6020A	**0.288**		mg/Kg	0.049	5	05/24/17 16:47	05/17/17	
Cobalt	6020A	**0.100**		mg/Kg	0.0049	5	05/24/17 16:47	05/17/17	
Copper	6020A	**1.47**		mg/Kg	0.025	5	05/24/17 16:47	05/17/17	
Iron	6020A	**49.3**		mg/Kg	0.25	5	05/24/17 16:47	05/17/17	
Lead	6020A	**0.278**		mg/Kg	0.0049	5	05/24/17 16:47	05/17/17	
Magnesium	6010C	**715**		mg/Kg	0.12	1	05/24/17 14:33	05/17/17	
Manganese	6020A	**3.75**		mg/Kg	0.012	5	05/24/17 16:47	05/17/17	
Nickel	6020A	**0.339**		mg/Kg	0.049	5	05/24/17 16:47	05/17/17	
Potassium	6010C	**2550**		mg/Kg	9.9	1	05/24/17 14:33	05/17/17	
Selenium	7742	**1.10**		mg/Kg	0.049	10	05/26/17 13:57	05/17/17	
Silver	6020A	**0.0173**		mg/Kg	0.0049	5	05/24/17 16:47	05/17/17	
Sodium	6010C	**4430**		mg/Kg	4.9	1	05/24/17 14:33	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0049	5	05/24/17 16:47	05/17/17	
Vanadium	6020A	**0.342**		mg/Kg	0.049	5	05/24/17 16:47	05/17/17	
Zinc	6020A	**16.3**		mg/Kg	0.12	5	05/24/17 16:47	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	REF-MUSSEL-01	**Basis:**	Wet
Lab Code:	K1704545-024		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**50.8**	mg/Kg	0.45	5	05/24/17 16:51	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.011	5	05/24/17 16:51	05/17/17	
Arsenic	6020A	**2.58**	mg/Kg	0.11	5	05/24/17 16:51	05/17/17	
Barium	6020A	**1.75**	mg/Kg	0.011	5	05/24/17 16:51	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.0045	5	05/24/17 16:51	05/17/17	
Cadmium	6020A	**1.18**	mg/Kg	0.0045	5	05/24/17 16:51	05/17/17	
Calcium	6010C	**2310**	mg/Kg	0.45	1	05/24/17 14:45	05/17/17	
Chromium	6020A	**0.208**	mg/Kg	0.045	5	05/24/17 16:51	05/17/17	
Cobalt	6020A	**0.127**	mg/Kg	0.0045	5	05/24/17 16:51	05/17/17	
Copper	6020A	**1.53**	mg/Kg	0.022	5	05/24/17 16:51	05/17/17	
Iron	6020A	**106**	mg/Kg	0.22	5	05/24/17 16:51	05/17/17	
Lead	6020A	**0.110**	mg/Kg	0.0045	5	05/24/17 16:51	05/17/17	
Magnesium	6010C	**578**	mg/Kg	0.11	1	05/24/17 14:45	05/17/17	
Manganese	6020A	**3.63**	mg/Kg	0.011	5	05/24/17 16:51	05/17/17	
Nickel	6020A	**0.379**	mg/Kg	0.045	5	05/24/17 16:51	05/17/17	
Potassium	6010C	**2790**	mg/Kg	8.9	1	05/24/17 14:45	05/17/17	
Selenium	7742	**1.32**	mg/Kg	0.089	20	05/26/17 14:01	05/17/17	
Silver	6020A	**0.0232**	mg/Kg	0.0045	5	05/24/17 16:51	05/17/17	
Sodium	6010C	**3170**	mg/Kg	4.5	1	05/24/17 14:45	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.0045	5	05/24/17 16:51	05/17/17	
Vanadium	6020A	**0.535**	mg/Kg	0.045	5	05/24/17 16:51	05/17/17	
Zinc	6020A	**19.0**	mg/Kg	0.11	5	05/24/17 16:51	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	REF-MUSSEL-02	**Basis:**	Wet
Lab Code:	K1704545-025		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**49.3**	mg/Kg	0.49	5	05/24/17 16:55	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.012	5	05/24/17 16:55	05/17/17	
Arsenic	6020A	**3.03**	mg/Kg	0.12	5	05/24/17 16:55	05/17/17	
Barium	6020A	**1.88**	mg/Kg	0.012	5	05/24/17 16:55	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.0049	5	05/24/17 16:55	05/17/17	
Cadmium	6020A	**1.50**	mg/Kg	0.0049	5	05/24/17 16:55	05/17/17	
Calcium	6010C	**2160**	mg/Kg	0.49	1	05/24/17 14:47	05/17/17	
Chromium	6020A	**0.272**	mg/Kg	0.049	5	05/24/17 16:55	05/17/17	
Cobalt	6020A	**0.141**	mg/Kg	0.0049	5	05/24/17 16:55	05/17/17	
Copper	6020A	**1.96**	mg/Kg	0.024	5	05/24/17 16:55	05/17/17	
Iron	6020A	**106**	mg/Kg	0.24	5	05/24/17 16:55	05/17/17	
Lead	6020A	**0.115**	mg/Kg	0.0049	5	05/24/17 16:55	05/17/17	
Magnesium	6010C	**609**	mg/Kg	0.12	1	05/24/17 14:47	05/17/17	
Manganese	6020A	**3.81**	mg/Kg	0.012	5	05/24/17 16:55	05/17/17	
Nickel	6020A	**0.441**	mg/Kg	0.049	5	05/24/17 16:55	05/17/17	
Potassium	6010C	**2810**	mg/Kg	9.8	1	05/24/17 14:47	05/17/17	
Selenium	7742	**1.57**	mg/Kg	0.098	20	05/26/17 14:10	05/17/17	
Silver	6020A	**0.0357**	mg/Kg	0.0049	5	05/24/17 16:55	05/17/17	
Sodium	6010C	**3420**	mg/Kg	4.9	1	05/24/17 14:47	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.0049	5	05/24/17 16:55	05/17/17	
Vanadium	6020A	**0.568**	mg/Kg	0.049	5	05/24/17 16:55	05/17/17	
Zinc	6020A	**21.6**	mg/Kg	0.12	5	05/24/17 16:55	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue		**Date Received:**	05/08/17 08:40
Sample Name:	REF-MUSSEL-03		**Basis:**	Wet
Lab Code:	K1704545-026			

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**32.1**		mg/Kg	0.38	5	05/24/17 17:00	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.0095	5	05/24/17 17:00	05/17/17	
Arsenic	6020A	**2.09**		mg/Kg	0.095	5	05/24/17 17:00	05/17/17	
Barium	6020A	**1.21**		mg/Kg	0.0095	5	05/24/17 17:00	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0038	5	05/24/17 17:00	05/17/17	
Cadmium	6020A	**1.11**		mg/Kg	0.0038	5	05/24/17 17:00	05/17/17	
Calcium	6010C	**635**		mg/Kg	0.38	1	05/24/17 14:50	05/17/17	
Chromium	6020A	**0.357**		mg/Kg	0.038	5	05/24/17 17:00	05/17/17	
Cobalt	6020A	**0.0947**		mg/Kg	0.0038	5	05/24/17 17:00	05/17/17	
Copper	6020A	**3.02**		mg/Kg	0.019	5	05/24/17 17:00	05/17/17	
Iron	6020A	**74.5**		mg/Kg	0.19	5	05/24/17 17:00	05/17/17	
Lead	6020A	**0.100**		mg/Kg	0.0038	5	05/24/17 17:00	05/17/17	
Magnesium	6010C	**528**		mg/Kg	0.095	1	05/24/17 14:50	05/17/17	
Manganese	6020A	**2.31**		mg/Kg	0.0095	5	05/24/17 17:00	05/17/17	
Nickel	6020A	**0.426**		mg/Kg	0.038	5	05/24/17 17:00	05/17/17	
Potassium	6010C	**2480**		mg/Kg	7.6	1	05/24/17 14:50	05/17/17	
Selenium	7742	**1.27**		mg/Kg	0.076	20	05/26/17 14:15	05/17/17	
Silver	6020A	**0.0261**		mg/Kg	0.0038	5	05/24/17 17:00	05/17/17	
Sodium	6010C	**3010**		mg/Kg	3.8	1	05/24/17 14:50	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0038	5	05/24/17 17:00	05/17/17	
Vanadium	6020A	**0.251**		mg/Kg	0.038	5	05/24/17 17:00	05/17/17	
Zinc	6020A	**19.1**		mg/Kg	0.095	5	05/24/17 17:00	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	REF-MUSSEL-04	**Basis:**	Wet
Lab Code:	K1704545-027		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**19.8**	mg/Kg	0.43	5	05/24/17 17:04	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.011	5	05/24/17 17:04	05/17/17	
Arsenic	6020A	**2.27**	mg/Kg	0.11	5	05/24/17 17:04	05/17/17	
Barium	6020A	**1.18**	mg/Kg	0.011	5	05/24/17 17:04	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.0043	5	05/24/17 17:04	05/17/17	
Cadmium	6020A	**1.33**	mg/Kg	0.0043	5	05/24/17 17:04	05/17/17	
Calcium	6010C	**6700**	mg/Kg	0.43	1	05/24/17 14:52	05/17/17	
Chromium	6020A	**0.244**	mg/Kg	0.043	5	05/24/17 17:04	05/17/17	
Cobalt	6020A	**0.0928**	mg/Kg	0.0043	5	05/24/17 17:04	05/17/17	
Copper	6020A	**1.50**	mg/Kg	0.021	5	05/24/17 17:04	05/17/17	
Iron	6020A	**49.7**	mg/Kg	0.21	5	05/24/17 17:04	05/17/17	
Lead	6020A	**0.0877**	mg/Kg	0.0043	5	05/24/17 17:04	05/17/17	
Magnesium	6010C	**542**	mg/Kg	0.11	1	05/24/17 14:52	05/17/17	
Manganese	6020A	**2.36**	mg/Kg	0.011	5	05/24/17 17:04	05/17/17	
Nickel	6020A	**0.343**	mg/Kg	0.043	5	05/24/17 17:04	05/17/17	
Potassium	6010C	**2530**	mg/Kg	8.5	1	05/24/17 14:52	05/17/17	
Selenium	7742	**1.14**	mg/Kg	0.085	20	05/26/17 14:20	05/17/17	
Silver	6020A	**0.0192**	mg/Kg	0.0043	5	05/24/17 17:04	05/17/17	
Sodium	6010C	**3110**	mg/Kg	4.3	1	05/24/17 14:52	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.0043	5	05/24/17 17:04	05/17/17	
Vanadium	6020A	**0.171**	mg/Kg	0.043	5	05/24/17 17:04	05/17/17	
Zinc	6020A	**17.5**	mg/Kg	0.11	5	05/24/17 17:04	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	REF-MUSSEL-05	**Basis:**	Wet
Lab Code:	K1704545-028		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**31.6**	mg/Kg	0.35	5	05/24/17 17:09	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.0087	5	05/24/17 17:09	05/17/17	
Arsenic	6020A	**2.12**	mg/Kg	0.087	5	05/24/17 17:09	05/17/17	
Barium	6020A	**1.34**	mg/Kg	0.0087	5	05/24/17 17:09	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.0035	5	05/24/17 17:09	05/17/17	
Cadmium	6020A	**0.940**	mg/Kg	0.0035	5	05/24/17 17:09	05/17/17	
Calcium	6010C	**1330**	mg/Kg	0.35	1	05/24/17 14:55	05/17/17	
Chromium	6020A	**0.343**	mg/Kg	0.035	5	05/24/17 17:09	05/17/17	
Cobalt	6020A	**0.101**	mg/Kg	0.0035	5	05/24/17 17:09	05/17/17	
Copper	6020A	**2.11**	mg/Kg	0.017	5	05/24/17 17:09	05/17/17	
Iron	6020A	**76.1**	mg/Kg	0.17	5	05/24/17 17:09	05/17/17	
Lead	6020A	**0.0792**	mg/Kg	0.0035	5	05/24/17 17:09	05/17/17	
Magnesium	6010C	**450**	mg/Kg	0.087	1	05/24/17 14:55	05/17/17	
Manganese	6020A	**2.45**	mg/Kg	0.0087	5	05/24/17 17:09	05/17/17	
Nickel	6020A	**0.426**	mg/Kg	0.035	5	05/24/17 17:09	05/17/17	
Potassium	6010C	**1790**	mg/Kg	7.0	1	05/24/17 14:55	05/17/17	
Selenium	7742	**1.24**	mg/Kg	0.070	20	05/26/17 14:24	05/17/17	
Silver	6020A	**0.0193**	mg/Kg	0.0035	5	05/24/17 17:09	05/17/17	
Sodium	6010C	**2450**	mg/Kg	3.5	1	05/24/17 14:55	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.0035	5	05/24/17 17:09	05/17/17	
Vanadium	6020A	**0.346**	mg/Kg	0.035	5	05/24/17 17:09	05/17/17	
Zinc	6020A	**16.6**	mg/Kg	0.087	5	05/24/17 17:09	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	REF-PRAWN-01	**Basis:**	Wet
Lab Code:	K1704545-029		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**1.22**		mg/Kg	0.42	5	05/24/17 17:26	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.010	5	05/24/17 17:26	05/17/17	
Arsenic	6020A	**5.89**		mg/Kg	0.10	5	05/24/17 17:26	05/17/17	
Barium	6020A	**0.060**		mg/Kg	0.010	5	05/24/17 17:26	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0042	5	05/24/17 17:26	05/17/17	
Cadmium	6020A	**0.165**		mg/Kg	0.0042	5	05/24/17 17:26	05/17/17	
Calcium	6010C	**886**		mg/Kg	0.42	1	05/24/17 14:57	05/17/17	
Chromium	6020A	**0.332**		mg/Kg	0.042	5	05/24/17 17:26	05/17/17	
Cobalt	6020A	**0.0155**		mg/Kg	0.0042	5	05/24/17 17:26	05/17/17	
Copper	6020A	**7.39**		mg/Kg	0.021	5	05/24/17 17:26	05/17/17	
Iron	6020A	**7.72**		mg/Kg	0.21	5	05/24/17 17:26	05/17/17	
Lead	6020A	**0.0051**		mg/Kg	0.0042	5	05/24/17 17:26	05/17/17	
Magnesium	6010C	**411**		mg/Kg	0.10	1	05/24/17 14:57	05/17/17	
Manganese	6020A	**0.383**		mg/Kg	0.010	5	05/24/17 17:26	05/17/17	
Nickel	6020A	**0.150**		mg/Kg	0.042	5	05/24/17 17:26	05/17/17	
Potassium	6010C	**3150**		mg/Kg	8.4	1	05/24/17 14:57	05/17/17	
Selenium	7742	**0.279**		mg/Kg	0.021	5	05/26/17 14:29	05/17/17	
Silver	6020A	**0.153**		mg/Kg	0.0042	5	05/24/17 17:26	05/17/17	
Sodium	6010C	**3250**		mg/Kg	4.2	1	05/24/17 14:57	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0042	5	05/24/17 17:26	05/17/17	
Vanadium	6020A	ND	U	mg/Kg	0.042	5	05/24/17 17:26	05/17/17	
Zinc	6020A	**14.4**		mg/Kg	0.10	5	05/24/17 17:26	05/17/17	

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Superset Reference:

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/05/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	REF-PRAWN-02	**Basis:**	Wet
Lab Code:	K1704545-030		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**1.40**	mg/Kg	0.35	5	05/24/17 17:30	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.0089	5	05/24/17 17:30	05/17/17	
Arsenic	6020A	**4.26**	mg/Kg	0.089	5	05/24/17 17:30	05/17/17	
Barium	6020A	**0.0839**	mg/Kg	0.0089	5	05/24/17 17:30	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.0035	5	05/24/17 17:30	05/17/17	
Cadmium	6020A	**0.107**	mg/Kg	0.0035	5	05/24/17 17:30	05/17/17	
Calcium	6010C	**818**	mg/Kg	0.35	1	05/24/17 14:59	05/17/17	
Chromium	6020A	**1.04**	mg/Kg	0.035	5	05/24/17 17:30	05/17/17	
Cobalt	6020A	**0.0290**	mg/Kg	0.0035	5	05/24/17 17:30	05/17/17	
Copper	6020A	**69.6**	mg/Kg	0.018	5	05/24/17 17:30	05/17/17	
Iron	6020A	**242**	mg/Kg	0.18	5	05/24/17 17:30	05/17/17	
Lead	6020A	**0.0043**	mg/Kg	0.0035	5	05/24/17 17:30	05/17/17	
Magnesium	6010C	**337**	mg/Kg	0.089	1	05/24/17 14:59	05/17/17	
Manganese	6020A	**0.526**	mg/Kg	0.0089	5	05/24/17 17:30	05/17/17	
Nickel	6020A	**0.526**	mg/Kg	0.035	5	05/24/17 17:30	05/17/17	
Potassium	6010C	**2630**	mg/Kg	7.1	1	05/24/17 14:59	05/17/17	
Selenium	7742	**0.306**	mg/Kg	0.018	5	05/26/17 14:38	05/17/17	
Silver	6020A	**0.108**	mg/Kg	0.0035	5	05/24/17 17:30	05/17/17	
Sodium	6010C	**2580**	mg/Kg	3.5	1	05/24/17 14:59	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.0035	5	05/24/17 17:30	05/17/17	
Vanadium	6020A	ND U	mg/Kg	0.035	5	05/24/17 17:30	05/17/17	
Zinc	6020A	**10.7**	mg/Kg	0.089	5	05/24/17 17:30	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/05/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	REF-PRAWN-03	**Basis:**	Wet
Lab Code:	K1704545-031		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**1.32**	mg/Kg	0.42	5	05/24/17 17:35	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.011	5	05/24/17 17:35	05/17/17	
Arsenic	6020A	**4.97**	mg/Kg	0.11	5	05/24/17 17:35	05/17/17	
Barium	6020A	**0.061**	mg/Kg	0.011	5	05/24/17 17:35	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.0042	5	05/24/17 17:35	05/17/17	
Cadmium	6020A	**0.0887**	mg/Kg	0.0042	5	05/24/17 17:35	05/17/17	
Calcium	6010C	**873**	mg/Kg	0.42	1	05/24/17 15:02	05/17/17	
Chromium	6020A	**0.358**	mg/Kg	0.042	5	05/24/17 17:35	05/17/17	
Cobalt	6020A	**0.0128**	mg/Kg	0.0042	5	05/24/17 17:35	05/17/17	
Copper	6020A	**7.24**	mg/Kg	0.021	5	05/24/17 17:35	05/17/17	
Iron	6020A	**14.0**	mg/Kg	0.21	5	05/24/17 17:35	05/17/17	
Lead	6020A	ND U	mg/Kg	0.0042	5	05/24/17 17:35	05/17/17	
Magnesium	6010C	**410**	mg/Kg	0.11	1	05/24/17 15:02	05/17/17	
Manganese	6020A	**0.420**	mg/Kg	0.011	5	05/24/17 17:35	05/17/17	
Nickel	6020A	**0.171**	mg/Kg	0.042	5	05/24/17 17:35	05/17/17	
Potassium	6010C	**3150**	mg/Kg	8.4	1	05/24/17 15:02	05/17/17	
Selenium	7742	**0.266**	mg/Kg	0.021	5	05/26/17 14:43	05/17/17	
Silver	6020A	**0.159**	mg/Kg	0.0042	5	05/24/17 17:35	05/17/17	
Sodium	6010C	**2720**	mg/Kg	4.2	1	05/24/17 15:02	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.0042	5	05/24/17 17:35	05/17/17	
Vanadium	6020A	ND U	mg/Kg	0.042	5	05/24/17 17:35	05/17/17	
Zinc	6020A	**13.1**	mg/Kg	0.11	5	05/24/17 17:35	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	REF-CRAB-01	**Basis:**	Wet
Lab Code:	K1704545-032		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**7.22**		mg/Kg	0.32	5	05/24/17 17:39	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.0080	5	05/24/17 17:39	05/17/17	
Arsenic	6020A	**3.49**		mg/Kg	0.080	5	05/24/17 17:39	05/17/17	
Barium	6020A	**0.158**		mg/Kg	0.0080	5	05/24/17 17:39	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0032	5	05/24/17 17:39	05/17/17	
Cadmium	6020A	**0.107**		mg/Kg	0.0032	5	05/24/17 17:39	05/17/17	
Calcium	6010C	**1380**		mg/Kg	0.32	1	05/24/17 15:04	05/17/17	
Chromium	6020A	**0.206**		mg/Kg	0.032	5	05/24/17 17:39	05/17/17	
Cobalt	6020A	**0.101**		mg/Kg	0.0032	5	05/24/17 17:39	05/17/17	
Copper	6020A	**8.36**		mg/Kg	0.016	5	05/24/17 17:39	05/17/17	
Iron	6020A	**18.2**		mg/Kg	0.16	5	05/24/17 17:39	05/17/17	
Lead	6020A	**0.0170**		mg/Kg	0.0032	5	05/24/17 17:39	05/17/17	
Magnesium	6010C	**403**		mg/Kg	0.080	1	05/24/17 15:04	05/17/17	
Manganese	6020A	**0.363**		mg/Kg	0.0080	5	05/24/17 17:39	05/17/17	
Nickel	6020A	**0.121**		mg/Kg	0.032	5	05/24/17 17:39	05/17/17	
Potassium	6010C	**2610**		mg/Kg	6.4	1	05/24/17 15:04	05/17/17	
Selenium	7742	**0.497**		mg/Kg	0.016	5	05/26/17 14:47	05/17/17	
Silver	6020A	**0.183**		mg/Kg	0.0032	5	05/24/17 17:39	05/17/17	
Sodium	6010C	**5470**		mg/Kg	3.2	1	05/24/17 15:04	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0032	5	05/24/17 17:39	05/17/17	
Vanadium	6020A	**0.035**		mg/Kg	0.032	5	05/24/17 17:39	05/17/17	
Zinc	6020A	**32.4**		mg/Kg	0.080	5	05/24/17 17:39	05/17/17	

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	04/29/17
Sample Matrix:	Animal Tissue		**Date Received:**	05/08/17 08:40
Sample Name:	REF-CRAB-02		**Basis:**	Wet
Lab Code:	K1704545-033			

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**7.54**		mg/Kg	0.46	5	05/24/17 17:43	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.012	5	05/24/17 17:43	05/17/17	
Arsenic	6020A	**4.85**		mg/Kg	0.12	5	05/24/17 17:43	05/17/17	
Barium	6020A	**0.301**		mg/Kg	0.012	5	05/24/17 17:43	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0046	5	05/24/17 17:43	05/17/17	
Cadmium	6020A	**0.0426**		mg/Kg	0.0046	5	05/24/17 17:43	05/17/17	
Calcium	6010C	**1220**		mg/Kg	0.46	1	05/24/17 15:07	05/17/17	
Chromium	6020A	**0.254**		mg/Kg	0.046	5	05/24/17 17:43	05/17/17	
Cobalt	6020A	**0.0747**		mg/Kg	0.0046	5	05/24/17 17:43	05/17/17	
Copper	6020A	**8.41**		mg/Kg	0.023	5	05/24/17 17:43	05/17/17	
Iron	6020A	**19.7**		mg/Kg	0.23	5	05/24/17 17:43	05/17/17	
Lead	6020A	**0.0180**		mg/Kg	0.0046	5	05/24/17 17:43	05/17/17	
Magnesium	6010C	**396**		mg/Kg	0.12	1	05/24/17 15:07	05/17/17	
Manganese	6020A	**1.27**		mg/Kg	0.012	5	05/24/17 17:43	05/17/17	
Nickel	6020A	**0.136**		mg/Kg	0.046	5	05/24/17 17:43	05/17/17	
Potassium	6010C	**3470**		mg/Kg	9.3	1	05/24/17 15:07	05/17/17	
Selenium	7742	**0.611**		mg/Kg	0.023	5	05/26/17 14:52	05/17/17	
Silver	6020A	**0.188**		mg/Kg	0.0046	5	05/24/17 17:43	05/17/17	
Sodium	6010C	**3850**		mg/Kg	4.6	1	05/24/17 15:07	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0046	5	05/24/17 17:43	05/17/17	
Vanadium	6020A	ND	U	mg/Kg	0.046	5	05/24/17 17:43	05/17/17	
Zinc	6020A	**48.5**		mg/Kg	0.12	5	05/24/17 17:43	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/05/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17 08:40
Sample Name:	REF-CRAB-03	**Basis:**	Wet
Lab Code:	K1704545-034		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**6.65**		mg/Kg	0.32	5	05/24/17 17:48	05/17/17	
Antimony	6020A	ND	U	mg/Kg	0.0079	5	05/24/17 17:48	05/17/17	
Arsenic	6020A	**5.47**		mg/Kg	0.079	5	05/24/17 17:48	05/17/17	
Barium	6020A	**0.166**		mg/Kg	0.0079	5	05/24/17 17:48	05/17/17	
Beryllium	6020A	ND	U	mg/Kg	0.0032	5	05/24/17 17:48	05/17/17	
Cadmium	6020A	**0.0566**		mg/Kg	0.0032	5	05/24/17 17:48	05/17/17	
Calcium	6010C	**1120**		mg/Kg	0.32	1	05/24/17 14:20	05/17/17	
Chromium	6020A	**0.105**		mg/Kg	0.032	5	05/24/17 17:48	05/17/17	
Cobalt	6020A	**0.0942**		mg/Kg	0.0032	5	05/24/17 17:48	05/17/17	
Copper	6020A	**11.2**		mg/Kg	0.016	5	05/24/17 17:48	05/17/17	
Iron	6020A	**14.5**		mg/Kg	0.16	5	05/24/17 17:48	05/17/17	
Lead	6020A	**0.0104**		mg/Kg	0.0032	5	05/24/17 17:48	05/17/17	
Magnesium	6010C	**414**		mg/Kg	0.079	1	05/24/17 14:20	05/17/17	
Manganese	6020A	**0.584**		mg/Kg	0.0079	5	05/24/17 17:48	05/17/17	
Nickel	6020A	**0.075**		mg/Kg	0.032	5	05/24/17 17:48	05/17/17	
Potassium	6010C	**2330**		mg/Kg	6.3	1	05/24/17 14:20	05/17/17	
Selenium	7742	**0.528**		mg/Kg	0.032	10	05/26/17 13:29	05/17/17	
Silver	6020A	**0.255**		mg/Kg	0.0032	5	05/24/17 17:48	05/17/17	
Sodium	6010C	**5130**		mg/Kg	3.2	1	05/24/17 14:20	05/17/17	
Thallium	6020A	ND	U	mg/Kg	0.0032	5	05/24/17 17:48	05/17/17	
Vanadium	6020A	**0.033**		mg/Kg	0.032	5	05/24/17 17:48	05/17/17	
Zinc	6020A	**39.8**		mg/Kg	0.079	5	05/24/17 17:48	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/15/17 14:27
Sample Matrix:	Water	**Date Received:**	05/16/17 09:02
Sample Name:	Homog. Blank	**Basis:**	NA
Lab Code:	K1704545-035		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	**4.0**		ug/L	4.0	1	05/23/17 17:39	05/19/17	
Antimony	6020A	ND	U	ug/L	0.050	1	05/23/17 17:39	05/19/17	
Arsenic	6020A	ND	U	ug/L	0.50	1	05/23/17 17:39	05/19/17	
Barium	6020A	ND	U	ug/L	0.050	1	05/26/17 16:50	05/25/17	
Beryllium	6020A	ND	U	ug/L	0.020	1	05/23/17 17:39	05/19/17	
Cadmium	6020A	**0.028**		ug/L	0.020	1	05/23/17 17:39	05/19/17	
Calcium	6010C	ND	U	ug/L	21	1	05/23/17 14:30	05/19/17	
Chromium	6020A	ND	U	ug/L	0.20	1	05/26/17 16:50	05/25/17	
Cobalt	6020A	ND	U	ug/L	0.020	1	05/26/17 16:50	05/25/17	
Copper	6020A	**20.7**		ug/L	0.10	1	05/23/17 17:39	05/19/17	
Iron	6020A	**56.6**		ug/L	2.0	1	05/23/17 17:39	05/19/17	
Lead	6020A	**0.037**		ug/L	0.020	1	05/23/17 17:39	05/19/17	
Magnesium	6010C	**10.8**		ug/L	5.3	1	05/23/17 14:30	05/19/17	
Manganese	6020A	**0.050**		ug/L	0.050	1	05/26/17 16:50	05/25/17	
Mercury	7470A	ND	U	ug/L	0.20	1	05/25/17 07:27	05/24/17	
Nickel	6020A	ND	U	ug/L	0.20	1	05/26/17 16:50	05/25/17	
Potassium	6010C	ND	U	ug/L	210	1	05/23/17 14:30	05/19/17	
Selenium	6020A	ND	U	ug/L	1.0	1	05/23/17 17:39	05/19/17	
Silver	6020A	ND	U	ug/L	0.020	1	05/23/17 17:39	05/19/17	
Sodium	6010C	ND	U	ug/L	210	1	05/23/17 14:30	05/19/17	
Thallium	6020A	ND	U	ug/L	0.020	1	05/23/17 17:39	05/19/17	
Vanadium	6020A	ND	U	ug/L	0.20	1	05/23/17 17:39	05/19/17	
Zinc	6020A	ND	U	ug/L	2.0	1	05/26/17 16:50	05/25/17	

Analytical Report

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	NA
Sample Matrix:	Animal Tissue		**Date Received:**	NA
Sample Name:	Method Blank		**Basis:**	Wet
Lab Code:	KQ1706061-07			

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	ND U	mg/Kg	0.4	5	05/24/17 16:12	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.01	5	05/24/17 16:12	05/17/17	
Arsenic	6020A	ND U	mg/Kg	0.1	5	05/24/17 16:12	05/17/17	
Barium	6020A	ND U	mg/Kg	0.01	5	05/24/17 16:12	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.004	5	05/24/17 16:12	05/17/17	
Cadmium	6020A	ND U	mg/Kg	0.004	5	05/24/17 16:12	05/17/17	
Calcium	6010C	ND U	mg/Kg	0.4	1	05/24/17 14:10	05/17/17	
Chromium	6020A	ND U	mg/Kg	0.04	5	05/24/17 16:12	05/17/17	
Cobalt	6020A	ND U	mg/Kg	0.004	5	05/24/17 16:12	05/17/17	
Copper	6020A	ND U	mg/Kg	0.02	5	05/24/17 16:12	05/17/17	
Iron	6020A	ND U	mg/Kg	0.2	5	05/24/17 16:12	05/17/17	
Lead	6020A	ND U	mg/Kg	0.004	5	05/24/17 16:12	05/17/17	
Magnesium	6010C	ND U	mg/Kg	0.1	1	05/24/17 14:10	05/17/17	
Manganese	6020A	ND U	mg/Kg	0.01	5	05/24/17 16:12	05/17/17	
Nickel	6020A	ND U	mg/Kg	0.04	5	05/24/17 16:12	05/17/17	
Potassium	6010C	ND U	mg/Kg	8	1	05/24/17 14:10	05/17/17	
Selenium	7742	ND U	mg/Kg	0.02	5	05/26/17 13:15	05/17/17	
Silver	6020A	ND U	mg/Kg	0.004	5	05/24/17 16:12	05/17/17	
Sodium	6010C	ND U	mg/Kg	4	1	05/24/17 14:10	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.004	5	05/24/17 16:12	05/17/17	
Vanadium	6020A	ND U	mg/Kg	0.04	5	05/24/17 16:12	05/17/17	
Zinc	6020A	ND U	mg/Kg	0.1	5	05/24/17 16:12	05/17/17	

Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
Sample Matrix:	Animal Tissue	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Wet
Lab Code:	KQ1706062-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	ND U	mg/Kg	0.4	5	05/24/17 13:48	05/17/17	
Antimony	6020A	ND U	mg/Kg	0.01	5	05/24/17 13:48	05/17/17	
Arsenic	6020A	ND U	mg/Kg	0.1	5	05/24/17 13:48	05/17/17	
Barium	6020A	ND U	mg/Kg	0.01	5	05/24/17 13:48	05/17/17	
Beryllium	6020A	ND U	mg/Kg	0.004	5	05/24/17 13:48	05/17/17	
Cadmium	6020A	ND U	mg/Kg	0.004	5	05/24/17 13:48	05/17/17	
Calcium	6010C	ND U	mg/Kg	0.4	1	05/24/17 15:36	05/17/17	
Chromium	6020A	ND U	mg/Kg	0.04	5	05/24/17 13:48	05/17/17	
Cobalt	6020A	ND U	mg/Kg	0.004	5	05/24/17 13:48	05/17/17	
Copper	6020A	ND U	mg/Kg	0.02	5	05/24/17 13:48	05/17/17	
Iron	6020A	ND U	mg/Kg	0.2	5	05/25/17 11:18	05/17/17	
Lead	6020A	ND U	mg/Kg	0.004	5	05/24/17 13:48	05/17/17	
Magnesium	6010C	ND U	mg/Kg	0.1	1	05/24/17 15:36	05/17/17	
Manganese	6020A	ND U	mg/Kg	0.01	5	05/24/17 13:48	05/17/17	
Nickel	6020A	ND U	mg/Kg	0.04	5	05/24/17 13:48	05/17/17	
Potassium	6010C	ND U	mg/Kg	8	1	05/24/17 15:36	05/17/17	
Selenium	7742	ND U	mg/Kg	0.02	5	05/26/17 10:56	05/17/17	
Silver	6020A	ND U	mg/Kg	0.004	5	05/24/17 13:48	05/17/17	
Sodium	6010C	ND U	mg/Kg	4	1	05/24/17 15:36	05/17/17	
Thallium	6020A	ND U	mg/Kg	0.004	5	05/24/17 13:48	05/17/17	
Vanadium	6020A	ND U	mg/Kg	0.04	5	05/24/17 13:48	05/17/17	
Zinc	6020A	ND U	mg/Kg	0.1	5	05/24/17 13:48	05/17/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	KQ1706210-02		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Calcium	6010C	ND U	ug/L	21	1	05/23/17 14:25	05/19/17	
Magnesium	6010C	ND U	ug/L	5.3	1	05/23/17 14:25	05/19/17	
Potassium	6010C	ND U	ug/L	210	1	05/23/17 14:25	05/19/17	
Sodium	6010C	ND U	ug/L	210	1	05/23/17 14:25	05/19/17	

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Superset Reference:

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	KQ1706208-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	6020A	ND U	ug/L	4.0	1	05/23/17 17:35	05/19/17	
Antimony	6020A	ND U	ug/L	0.050	1	05/23/17 17:35	05/19/17	
Arsenic	6020A	ND U	ug/L	0.50	1	05/23/17 17:35	05/19/17	
Beryllium	6020A	ND U	ug/L	0.020	1	05/23/17 17:35	05/19/17	
Cadmium	6020A	ND U	ug/L	0.020	1	05/23/17 17:35	05/19/17	
Copper	6020A	ND U	ug/L	0.10	1	05/23/17 17:35	05/19/17	
Iron	6020A	ND U	ug/L	2.0	1	05/23/17 17:35	05/19/17	
Lead	6020A	ND U	ug/L	0.020	1	05/23/17 17:35	05/19/17	
Selenium	6020A	ND U	ug/L	1.0	1	05/23/17 17:35	05/19/17	
Silver	6020A	ND U	ug/L	0.020	1	05/23/17 17:35	05/19/17	
Thallium	6020A	ND U	ug/L	0.020	1	05/23/17 17:35	05/19/17	
Vanadium	6020A	ND U	ug/L	0.20	1	05/23/17 17:35	05/19/17	

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Analytical Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	KQ1706583-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Barium	6020A	ND U	ug/L	0.050	1	05/26/17 16:44	05/25/17	
Chromium	6020A	ND U	ug/L	0.20	1	05/26/17 16:44	05/25/17	
Cobalt	6020A	ND U	ug/L	0.020	1	05/26/17 16:44	05/25/17	
Manganese	6020A	ND U	ug/L	0.050	1	05/26/17 16:44	05/25/17	
Nickel	6020A	ND U	ug/L	0.20	1	05/26/17 16:44	05/25/17	
Zinc	6020A	ND U	ug/L	2.0	1	05/26/17 16:44	05/25/17	

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	KQ1706211-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Mercury	7470A	ND U	ug/L	0.20	1	05/25/17 07:24	05/24/17	

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project	Skagway Tissue/1657231	**Date Collected:**	05/05/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17
		Date Analyzed:	05/24/17 - 05/26/17

Replicate Sample Summary
Total Metals

Sample Name:	REF-CRAB-03	**Units:**	mg/Kg
Lab Code:	K1704545-034	**Basis:**	Wet

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1706061-05 Result	Average	RPD	RPD Limit
Aluminum	6020A	0.32	6.65	6.39	6.52	4	20
Antimony	6020A	0.0079	ND U	ND U	ND	-	20
Arsenic	6020A	0.079	5.47	5.63	5.55	3	20
Barium	6020A	0.0079	0.166	0.158	0.162	5	20
Beryllium	6020A	0.0032	ND U	ND U	ND	-	20
Cadmium	6020A	0.0032	0.0566	0.0613	0.0590	8	20
Calcium	6010C	0.32	1120	1010	1070	10	20
Chromium	6020A	0.032	0.105	0.108	0.107	2	20
Cobalt	6020A	0.0032	0.0942	0.0977	0.0960	4	20
Copper	6020A	0.016	11.2	11.3	11.3	1	20
Iron	6020A	0.16	14.5	14.3	14.4	1	20
Lead	6020A	0.0032	0.0104	0.0106	0.0105	2	20
Magnesium	6010C	0.079	414	415	415	<1	20
Manganese	6020A	0.0079	0.584	0.573	0.579	2	20
Nickel	6020A	0.032	0.075	0.076	0.076	2	20
Potassium	6010C	6.3	2330	2330	2330	<1	20
Selenium	7742	0.032	0.528	0.519	0.524	2	20
Silver	6020A	0.0032	0.255	0.273	0.264	7	20
Sodium	6010C	3.2	5130	5150	5140	<1	20
Thallium	6020A	0.0032	ND U	ND U	ND	-	20
Vanadium	6020A	0.032	0.033	0.034	0.034	2	20
Zinc	6020A	0.079	39.8	39.9	39.9	<1	20

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project	Skagway Tissue/1657231	**Date Collected:**	05/04/17
Sample Matrix:	Animal Tissue	**Date Received:**	05/08/17
		Date Analyzed:	05/24/17 - 05/26/17

Replicate Sample Summary
Total Metals

Sample Name:	NF-CRAB-02	**Units:**	mg/Kg
Lab Code:	K1704545-012	**Basis:**	Wet

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1706062-05 Result	Average	RPD	RPD Limit
Aluminum	6020A	0.42	7.10	6.87	6.99	3	20
Antimony	6020A	0.010	ND U	ND U	ND	-	20
Arsenic	6020A	0.10	3.97	3.89	3.93	2	20
Barium	6020A	0.010	0.173	0.206	0.190	17	20
Beryllium	6020A	0.0042	ND U	ND U	ND	-	20
Cadmium	6020A	0.0042	0.111	0.105	0.108	6	20
Calcium	6010C	0.42	939	1580	1260	51 *	20
Chromium	6020A	0.042	0.144	0.167	0.156	15	20
Cobalt	6020A	0.0042	0.0774	0.0767	0.0771	<1	20
Copper	6020A	0.021	8.26	8.14	8.20	1	20
Iron	6020A	0.21	32.7	22.9	27.8	35 *	20
Lead	6020A	0.0042	0.174	0.169	0.172	3	20
Magnesium	6010C	0.10	400	424	412	6	20
Manganese	6020A	0.010	0.501	0.536	0.519	7	20
Nickel	6020A	0.042	0.096	0.102	0.099	6	20
Potassium	6010C	8.3	3140	3200	3170	2	20
Selenium	7742	0.042	0.605	0.598	0.602	1	20
Silver	6020A	0.0042	0.117	0.113	0.115	3	20
Sodium	6010C	4.2	3910	3990	3950	2	20
Thallium	6020A	0.0042	ND U	ND U	ND	-	20
Vanadium	6020A	0.042	ND U	ND U	ND	-	20
Zinc	6020A	0.10	46.0	46.7	46.4	2	20

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QA/QC Report

Client: Golder Associates, Inc. **Service Request:** K1704545
Project Skagway Tissue/1657231 **Date Collected:** NA
Sample Matrix: Water **Date Received:** NA
Date Analyzed: 05/23/17

Replicate Sample Summary
Total Metals

Sample Name: Batch QC **Units:** ug/L
Lab Code: K1704900-012 **Basis:** NA

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1706210-03 Result	Average	RPD	RPD Limit
Calcium	6010C	21	29	29	29	2	20
Magnesium	6010C	5.3	ND U	ND U	ND	-	20
Potassium	6010C	210	ND U	ND U	ND	-	20
Sodium	6010C	210	ND U	ND U	ND	-	20

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project	Skagway Tissue/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	05/23/17

Replicate Sample Summary
Dissolved Metals

Sample Name:	Batch QC	**Units:**	ug/L
Lab Code:	K1704816-001	**Basis:**	NA

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1706208-03 Result	Average	RPD	RPD Limit
Aluminum	6020A	4.0	ND U	ND U	ND	-	20
Antimony	6020A	0.050	0.307	0.292	0.299	5	20
Arsenic	6020A	0.50	0.71	0.63	0.67	12	20
Beryllium	6020A	0.020	ND U	ND U	ND	-	20
Cadmium	6020A	0.020	0.035	0.023	0.029	44 #	20
Copper	6020A	0.10	1.90	1.93	1.91	2	20
Iron	6020A	2.0	2.6	2.4	2.5	11	20
Lead	6020A	0.020	0.052	0.039	0.045	30 #	20
Selenium	6020A	1.0	ND U	ND U	ND	-	20
Silver	6020A	0.020	ND U	ND U	ND	-	20
Thallium	6020A	0.020	ND U	ND U	ND	-	20
Vanadium	6020A	0.20	0.95	0.93	0.94	2	20

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Client: Golder Associates, Inc. **Service Request:** K1704545
Project Skagway Tissue/1657231 **Date Collected:** NA
Sample Matrix: Water **Date Received:** NA
Date Analyzed: 05/26/17

Replicate Sample Summary
Dissolved Metals

Sample Name: Batch QC **Units:** ug/L
Lab Code: K1704816-005 **Basis:** NA

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1706583-03 Result	Average	RPD	RPD Limit
Barium	6020A	0.050	18.7	18.3	18.5	3	20
Chromium	6020A	0.20	ND U	ND U	ND	-	20
Cobalt	6020A	0.020	0.199	0.195	0.197	2	20
Manganese	6020A	0.050	92.8	88.9	90.8	4	20
Nickel	6020A	0.20	4.25	4.04	4.15	5	20
Zinc	6020A	2.0	2.4	2.4	2.4	<1	20

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project	Skagway Tissue/1657231	**Date Collected:**	05/15/17
Sample Matrix:	Water	**Date Received:**	05/16/17
		Date Analyzed:	05/25/17

Replicate Sample Summary
Total Metals

Sample Name:	Homog. Blank	**Units:**	ug/L
Lab Code:	K1704545-035	**Basis:**	NA

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1706211-03 Result	Average	RPD	RPD Limit
Mercury	7470A	0.20	ND U	ND U	ND	-	20

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Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal Tissue

Service Request: K1704545
Date Collected: 05/05/17
Date Received: 05/08/17
Date Analyzed: 05/24/17 - 05/26/17

Matrix Spike Summary
Total Metals

Sample Name: REF-CRAB-03
Lab Code: K1704545-034

Units: mg/Kg
Basis: Wet

Matrix Spike
KQ1706061-06

Analyte Name	Method	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6020A	6.65	40.1	31.8	105	75-125
Antimony	6020A	ND U	8.59	7.95	108	75-125
Arsenic	6020A	5.47	8.60	2.66	118	75-125
Barium	6020A	0.166	16.4	15.9	102	75-125
Beryllium	6020A	ND U	0.810	0.795	102	75-125
Cadmium	6020A	0.0566	0.945	0.795	112	75-125
Calcium	6010C	1120	1010	26.6	-434 #	75-125
Chromium	6020A	0.105	3.63	3.18	111	75-125
Cobalt	6020A	0.0942	8.97	7.95	112	75-125
Copper	6020A	11.2	16.2	3.98	125	75-125
Iron	6020A	14.5	33.1	15.9	117	75-125
Lead	6020A	0.0104	7.19	7.95	90	75-125
Magnesium	6010C	414	457	26.6	162 #	75-125
Manganese	6020A	0.584	9.57	7.95	113	75-125
Nickel	6020A	0.075	8.52	7.95	106	75-125
Potassium	6010C	2330	2460	26.6	491 #	75-125
Selenium	7742	0.53	3.30	2.66	105	75-125
Silver	6020A	0.255	0.683	0.795	54 N	75-125
Sodium	6010C	5130	5320	26.6	725 #	75-125
Thallium	6020A	ND U	0.489	0.529	92	75-125
Vanadium	6020A	0.033	9.10	7.95	114	75-125
Zinc	6020A	39.8	49.3	7.95	120 #	75-125

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Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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Superset Reference:

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal Tissue

Service Request: K1704545
Date Collected: 05/04/17
Date Received: 05/08/17
Date Analyzed: 05/24/17 - 05/26/17

Matrix Spike Summary
Total Metals

Sample Name: NF-CRAB-02
Lab Code: K1704545-012

Units: mg/Kg
Basis: Wet

Matrix Spike
KQ1706062-06

Analyte Name	Method	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6020A	7.10	49.7	41.8	102	75-125
Antimony	6020A	ND U	11.2	10.5	108	75-125
Arsenic	6020A	3.97	7.72	3.49	108	75-125
Barium	6020A	0.173	20.9	20.9	99	75-125
Beryllium	6020A	ND U	1.09	1.05	104	75-125
Cadmium	6020A	0.111	1.27	1.05	111	75-125
Calcium	6010C	939	980	34.9	118 #	75-125
Chromium	6020A	0.144	4.48	4.18	104	75-125
Cobalt	6020A	0.0774	10.9	10.5	103	75-125
Copper	6020A	8.26	13.3	5.23	96	75-125
Iron	6020A	32.7	44.6	20.9	57 N	75-125
Lead	6020A	0.174	9.80	10.5	92	75-125
Magnesium	6010C	400	442	34.9	119 #	75-125
Manganese	6020A	0.501	11.7	10.5	107	75-125
Nickel	6020A	0.096	10.6	10.5	100	75-125
Potassium	6010C	3140	3240	34.9	300 #	75-125
Selenium	7742	0.60	4.10	3.49	100	75-125
Silver	6020A	0.117	1.21	1.05	104	75-125
Sodium	6010C	3910	4090	34.9	511 #	75-125
Thallium	6020A	ND U	0.653	0.696	94	75-125
Vanadium	6020A	ND U	11.0	10.5	106	75-125
Zinc	6020A	46.0	56.9	10.5	104 #	75-125

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Superset Reference:

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	05/23/17
		Date Extracted:	05/19/17

Matrix Spike Summary
Total Metals

Sample Name:	Batch QC	**Units:**	ug/L
Lab Code:	K1704900-012	**Basis:**	NA
Analysis Method:	6010C		
Prep Method:	EPA CLP-METALS ILM04.0		

Matrix Spike
KQ1706210-04

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Calcium	29	9400	10000	94	75-125
Magnesium	ND U	9860	10000	99	75-125
Potassium	ND U	9810	10000	98	75-125
Sodium	ND U	9960	10000	99	75-125

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Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	05/23/17
		Date Extracted:	05/19/17

Matrix Spike Summary
Dissolved Metals

Sample Name:	Batch QC	**Units:**	ug/L
Lab Code:	K1704816-001	**Basis:**	NA
Analysis Method:	6020A		
Prep Method:	EPA CLP-METALS ILM04.0		

Matrix Spike
KQ1706208-04

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	ND U	98.4	100	95	75-125
Antimony	0.307	50.5	50.0	100	75-125
Arsenic	0.71	53.2	50.0	105	75-125
Beryllium	ND U	2.43	2.50	97	75-125
Cadmium	0.035	24.0	25.0	96	75-125
Copper	1.90	14.6	12.5	102	75-125
Iron	2.6	53.3	50.0	101	75-125
Lead	0.052	45.9	50.0	92	75-125
Selenium	ND U	51.1	50.0	102	75-125
Silver	ND U	11.6	12.5	93	75-125
Thallium	ND U	46.8	50.0	94	75-125
Vanadium	0.95	27.3	25.0	105	75-125

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	05/26/17
		Date Extracted:	05/25/17

Matrix Spike Summary
Dissolved Metals

Sample Name:	Batch QC	**Units:**	ug/L
Lab Code:	K1704816-005	**Basis:**	NA
Analysis Method:	6020A		
Prep Method:	EPA CLP-METALS ILM04.0		

Matrix Spike
KQ1706583-04

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Barium	18.7	120	100	101	75-125
Chromium	ND U	10.3	10.0	103	75-125
Cobalt	0.199	24.4	25.0	97	75-125
Manganese	92.8	111	25.0	73 N	75-125
Nickel	4.25	27.7	25.0	94	75-125
Zinc	2.4	24.3	25.0	88	75-125

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/15/17
Sample Matrix:	Water	**Date Received:**	05/16/17
		Date Analyzed:	05/25/17
		Date Extracted:	05/24/17

Matrix Spike Summary
Total Metals

Sample Name:	Homog. Blank	**Units:**	ug/L
Lab Code:	K1704545-035	**Basis:**	NA
Analysis Method:	7470A		
Prep Method:	Method		

Matrix Spike
KQ1706211-04

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Mercury	ND U	3.63	5.00	73 N	75-125

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal Tissue

Service Request: K1704545
Date Analyzed: 05/24/17

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Wet

Lab Control Sample
KQ1706061-08

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Calcium	6010C	176	167	106	80-120
Magnesium	6010C	169	167	102	80-120
Potassium	6010C	163	167	98	80-120
Sodium	6010C	167	167	100	80-120

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal Tissue

Service Request: K1704545
Date Analyzed: 05/24/17

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Wet

Lab Control Sample
KQ1706061-08

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6020A	216	200	108	80-120
Antimony	6020A	50.5	50.0	101	80-120
Arsenic	6020A	17.0	16.7	102	80-120
Barium	6020A	96.2	100	96	80-120
Beryllium	6020A	5.26	5.00	105	80-120
Cadmium	6020A	5.32	5.00	106	80-120
Chromium	6020A	21.3	20.0	106	80-120
Cobalt	6020A	53.5	50.0	107	80-120
Copper	6020A	26.2	25.0	105	80-120
Iron	6020A	106	100	106	80-120
Lead	6020A	50.0	50.0	100	80-120
Manganese	6020A	52.5	50.0	105	80-120
Nickel	6020A	52.9	50.0	106	80-120
Silver	6020A	5.36	5.00	107	80-120
Thallium	6020A	3.39	3.33	102	80-120
Vanadium	6020A	51.7	50.0	103	80-120
Zinc	6020A	51.9	50.0	104	80-120

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal Tissue

Service Request: K1704545
Date Analyzed: 05/26/17

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Wet

Lab Control Sample
KQ1706061-08

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Selenium	7742	16.4	16.7	98	80-120

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal Tissue

Service Request: K1704545
Date Analyzed: 05/24/17

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Wet

Lab Control Sample
KQ1706062-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Calcium	6010C	176	167	105	80-120
Magnesium	6010C	172	167	103	80-120
Potassium	6010C	168	167	101	80-120
Sodium	6010C	166	167	99	80-120

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Analyzed:**	05/24/17
Sample Matrix:	Animal Tissue		

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Wet

Lab Control Sample
KQ1706062-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6020A	206	200	103	80-120
Antimony	6020A	52.0	50.0	104	80-120
Arsenic	6020A	17.3	16.7	104	80-120
Barium	6020A	100	100	100	80-120
Beryllium	6020A	5.15	5.00	103	80-120
Cadmium	6020A	5.31	5.00	106	80-120
Chromium	6020A	20.9	20.0	104	80-120
Cobalt	6020A	52.2	50.0	104	80-120
Copper	6020A	25.8	25.0	103	80-120
Iron	6020A	103	100	103	80-120
Lead	6020A	51.1	50.0	102	80-120
Manganese	6020A	52.8	50.0	106	80-120
Nickel	6020A	52.0	50.0	104	80-120
Silver	6020A	5.45	5.00	109	80-120
Thallium	6020A	3.47	3.33	104	80-120
Vanadium	6020A	52.3	50.0	105	80-120
Zinc	6020A	51.3	50.0	103	80-120

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Analyzed:**	05/26/17
Sample Matrix:	Animal Tissue		

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Wet

Lab Control Sample
KQ1706062-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Selenium	7742	16.9	16.7	101	80-120

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Superset Reference:

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Water

Service Request: K1704545
Date Analyzed: 05/23/17

Lab Control Sample Summary
Total Metals

Units: ug/L
Basis: NA

Lab Control Sample
KQ1706210-01

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Calcium	6010C	12800	12500	102	80-120
Magnesium	6010C	13000	12500	104	80-120
Potassium	6010C	13400	12500	107	80-120
Sodium	6010C	13200	12500	106	80-120

Client: Golder Associates, Inc. **Service Request:** K1704545
Project: Skagway Tissue/1657231 **Date Analyzed:** 05/23/17
Sample Matrix: Water

Lab Control Sample Summary
Total Metals

Units:ug/L
Basis:NA

Lab Control Sample
KQ1706208-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	6020A	112	100	112	80-120
Antimony	6020A	54.8	50.0	110	80-120
Arsenic	6020A	55.9	50.0	112	80-120
Beryllium	6020A	2.65	2.50	106	80-120
Cadmium	6020A	28.2	25.0	113	80-120
Copper	6020A	14.7	12.5	118	80-120
Iron	6020A	57.9	50.0	116	80-120
Lead	6020A	54.7	50.0	109	80-120
Selenium	6020A	56.4	50.0	113	80-120
Silver	6020A	14.0	12.5	112	80-120
Thallium	6020A	54.8	50.0	110	80-120
Vanadium	6020A	27.7	25.0	111	80-120

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Analyzed:**	05/26/17
Sample Matrix:	Water		

Lab Control Sample Summary
Total Metals

Units:ug/L
Basis:NA

Lab Control Sample
KQ1706583-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Barium	6020A	102	100	102	80-120
Chromium	6020A	10.3	10.0	103	80-120
Cobalt	6020A	25.5	25.0	102	80-120
Manganese	6020A	25.2	25.0	101	80-120
Nickel	6020A	25.3	25.0	101	80-120
Zinc	6020A	24.5	25.0	98	80-120

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Water

Service Request: K1704545
Date Analyzed: 05/25/17

Lab Control Sample Summary
Total Metals

Units: ug/L
Basis: NA

Lab Control Sample
KQ1706211-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Mercury	7470A	4.45	5.00	89	80-120

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	05/17/17
		Date Analyzed:	05/24-26/17

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	KQ1706062-03-SRM1	Basis:	Dry
Test Notes:	Dorm-4 Solids = 94.5%		

Source: N.R.C.C. Dorm-4

Analyte	**Prep Method**	**Analysis Method**	**True Value**	**Result**	**Percent Recovery**	**Control Limits**	**Result Notes**
Arsenic	PSEP Tissue	6020A	6.8	8.0	118	4.93-8.93	
Cadmium	PSEP Tissue	6020A	0.306	0.328	107	0.233 - 0.385	
Chromium	PSEP Tissue	6020A	1.87	1.75	94	1.37-2.44	
Copper	PSEP Tissue	6020A	15.9	16.1	101	12.0 - 20.2	
Iron	PSEP Tissue	6020A	341	354	104	251-442	
Lead	PSEP Tissue	6020A	0.416	0.319	77	0.290 - 0.563	
Nickel	PSEP Tissue	6020A	1.36	1.34	99	0.912-1.9	
Selenium	PSEP Tissue	7742	3.56	3.67	103	2.58 - 4.68	
Zinc	PSEP Tissue	6020A	52.20	56.2	108	39.2 - 66.5	

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	05/17/17
		Date Analyzed:	05/24-26/17

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	KQ1706062-04-SRM1	Basis:	Dry
Test Notes:	Tort-3 Solids = 99.1%		

Source: N.R.C.C. Tort-3

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	Control Limits	Result Notes
Arsenic	PSEP Tissue	6020A	59.5	69.4	117	44.6-76.0	
Cadmium	PSEP Tissue	6020A	42.3	43.0	102	32.4-52.9	
Chromium	PSEP Tissue	6020A	1.95	1.71	88	1.37-2.63	
Copper	PSEP Tissue	6020A	497	454	91	380-623	
Iron	PSEP Tissue	6020A	179	166	93	137-224	
Lead	PSEP Tissue	6020A	0.225	0.187	83	0.166-0.292	
Manganese	PSEP Tissue	6020A	15.6	14.8	95	11.7-19.9	
Nickel	PSEP Tissue	6020A	5.3	5.0	94	4.05-6.65	
Selenium	PSEP Tissue	7742	10.9	10.6	97	7.9-14.3	
Vanadium	PSEP Tissue	6020A	9.1	8.9	98	7.0-11.4	
Zinc	PSEP Tissue	6020A	136	136	100	104-170	

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	05/17/17
		Date Analyzed:	05/24-26/17

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	KQ1706061-09-SRM3	Basis:	Dry
Test Notes:	Dorm-4 Solids = 94.5%		

Source: N.R.C.C. Dorm-4

Analyte	**Prep Method**	**Analysis Method**	**True Value**	**Result**	**Percent Recovery**	**Control Limits**	**Result Notes**
Arsenic	PSEP Tissue	6020A	6.8	7.5	110	4.93-8.93	
Cadmium	PSEP Tissue	6020A	0.306	0.345	113	0.233 - 0.385	
Chromium	PSEP Tissue	6020A	1.87	2.24	120	1.37-2.44	
Copper	PSEP Tissue	6020A	15.9	16.0	101	12.0 - 20.2	
Iron	PSEP Tissue	6020A	341	357	105	251-442	
Lead	PSEP Tissue	6020A	0.416	0.307	74	0.290 - 0.563	
Nickel	PSEP Tissue	6020A	1.36	1.35	99	0.912-1.9	
Selenium	PSEP Tissue	7742	3.56	3.17	89	2.58 - 4.68	
Zinc	PSEP Tissue	6020A	52.20	54.7	105	39.2 - 66.5	

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QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	05/17/17
		Date Analyzed:	05/24-26/17

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	KQ1706061-10-SRM4	Basis:	Dry
Test Notes:	Tort-3 Solids = 99.1%		

Source: N.R.C.C. Tort-3

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	Control Limits	Result Notes
Arsenic	PSEP Tissue	6020A	59.5	70.0	118	44.6-76.0	
Cadmium	PSEP Tissue	6020A	42.3	45.2	107	32.4-52.9	
Chromium	PSEP Tissue	6020A	1.95	1.89	97	1.37-2.63	
Copper	PSEP Tissue	6020A	497	466	94	380-623	
Iron	PSEP Tissue	6020A	179	171	96	137-224	
Lead	PSEP Tissue	6020A	0.225	0.185	82	0.166-0.292	
Manganese	PSEP Tissue	6020A	15.6	16.4	105	11.7-19.9	
Nickel	PSEP Tissue	6020A	5.3	5.1	96	4.05-6.65	
Selenium	PSEP Tissue	7742	10.9	10.8	99	7.9-14.3	
Vanadium	PSEP Tissue	6020A	9.1	9.3	102	7.0-11.4	
Zinc	PSEP Tissue	6020A	136	139	102	104-170	

Polynuclear Aromatic Hydrocarbons

ALS Environmental—Kelso Laboratory
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www.alsglobal.com

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-PRAWN-01	**Units:**	ug/Kg
Lab Code:	K1704545-001	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.1	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	80	42-106	05/30/17	Acceptable
Fluoranthene-d10	84	45-109	05/30/17	Acceptable
Terphenyl-d14	87	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-PRAWN-02	**Units:**	ug/Kg
Lab Code:	K1704545-002	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	**5.7**		5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	**22**		5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	70	42-106	05/30/17	Acceptable
Fluoranthene-d10	72	45-109	05/30/17	Acceptable
Terphenyl-d14	78	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

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Analytical Results

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal tissue

Service Request: K1704545
Date Collected: 05/04/2017
Date Received: 05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name: NF-PRAWN-03
Lab Code: K1704545-003

Units: ug/Kg
Basis: Wet

Extraction Method: EPA 3541
Analysis Method: 8270D SIM

Level: Low

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	8.4	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	66	42-106	05/30/17	Acceptable
Fluoranthene-d10	72	45-109	05/30/17	Acceptable
Terphenyl-d14	79	41-102	05/30/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-PRAWN-04	**Units:**	ug/Kg
Lab Code:	K1704545-004	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	70	42-106	05/30/17	Acceptable
Fluoranthene-d10	73	45-109	05/30/17	Acceptable
Terphenyl-d14	81	41-102	05/30/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-PRAWN-05	**Units:**	ug/Kg
Lab Code:	K1704545-005	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	68	42-106	05/30/17	Acceptable
Fluoranthene-d10	72	45-109	05/30/17	Acceptable
Terphenyl-d14	81	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-MUSSEL-01	**Units:**	ug/Kg
Lab Code:	K1704545-006	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	**33**		5.5	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	**50**		5.5	1	05/24/17	05/30/17	KWG1704277	
Pyrene	**30**		5.5	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	**8.5**		5.5	1	05/24/17	05/30/17	KWG1704277	
Chrysene	**13**		5.5	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	**11**		5.5	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	69	42-106	05/30/17	Acceptable
Fluoranthene-d10	72	45-109	05/30/17	Acceptable
Terphenyl-d14	77	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue		**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-MUSSEL-02		**Units:**	ug/Kg
Lab Code:	K1704545-007		**Basis:**	Wet
Extraction Method:	EPA 3541		**Level:**	Low
Analysis Method:	8270D SIM			

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	**5.3**		5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	**40**		5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	**49**		5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	**25**		5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	**11**		5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	**16**		5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	**12**		5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	73	42-106	05/30/17	Acceptable
Fluoranthene-d10	75	45-109	05/30/17	Acceptable
Terphenyl-d14	78	41-102	05/30/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-MUSSEL-03	**Units:**	ug/Kg
Lab Code:	K1704545-008	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	**35**		5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	**51**		5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	**31**		5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	**9.1**		5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	**13**		5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	**9.7**		5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	72	42-106	05/30/17	Acceptable
Fluoranthene-d10	75	45-109	05/30/17	Acceptable
Terphenyl-d14	79	41-102	05/30/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue		**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-MUSSEL-04		**Units:**	ug/Kg
Lab Code:	K1704545-009		**Basis:**	Wet
Extraction Method:	EPA 3541		**Level:**	Low
Analysis Method:	8270D SIM			

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	**5.1**		5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	**38**		5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	**53**		5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	**29**		5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	**9.4**		5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	**15**		5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	**12**		5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	**5.5**		5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	67	42-106	05/30/17	Acceptable
Fluoranthene-d10	72	45-109	05/30/17	Acceptable
Terphenyl-d14	77	41-102	05/30/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-MUSSEL-05	**Units:**	ug/Kg
Lab Code:	K1704545-010	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Fluorene	**6.1**		5.5	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	**51**		5.5	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	**81**		5.5	1	05/24/17	05/30/17	KWG1704277	
Pyrene	**44**		5.5	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	**13**		5.5	1	05/24/17	05/30/17	KWG1704277	
Chrysene	**20**		5.5	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	**15**		5.5	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	**7.5**		5.5	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.5	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	77	42-106	05/30/17	Acceptable
Fluoranthene-d10	82	45-109	05/30/17	Acceptable
Terphenyl-d14	85	41-102	05/30/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	05/01/2017
Sample Matrix:	Animal tissue		**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-CRAB-01		**Units:**	ug/Kg
Lab Code:	K1704545-011		**Basis:**	Wet
Extraction Method:	EPA 3541		**Level:**	Low
Analysis Method:	8270D SIM			

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	70	42-106	05/30/17	Acceptable
Fluoranthene-d10	76	45-109	05/30/17	Acceptable
Terphenyl-d14	83	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-CRAB-02	**Units:**	ug/Kg
Lab Code:	K1704545-012	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	72	42-106	05/30/17	Acceptable
Fluoranthene-d10	75	45-109	05/30/17	Acceptable
Terphenyl-d14	83	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-CRAB-03	**Units:**	ug/Kg
Lab Code:	K1704545-013	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	71	42-106	05/30/17	Acceptable
Fluoranthene-d10	75	45-109	05/30/17	Acceptable
Terphenyl-d14	83	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	MF-CRAB-01	**Units:**	ug/Kg
Lab Code:	K1704545-014	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	70	42-106	05/30/17	Acceptable
Fluoranthene-d10	72	45-109	05/30/17	Acceptable
Terphenyl-d14	78	41-102	05/30/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	MF-CRAB-02	**Units:**	ug/Kg
Lab Code:	K1704545-015	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	62	42-106	05/30/17	Acceptable
Fluoranthene-d10	66	45-109	05/30/17	Acceptable
Terphenyl-d14	73	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	MF-CRAB-03	**Units:**	ug/Kg
Lab Code:	K1704545-016	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	67	42-106	05/30/17	Acceptable
Fluoranthene-d10	75	45-109	05/30/17	Acceptable
Terphenyl-d14	83	41-102	05/30/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/03/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	MF-CRAB-04	**Units:**	ug/Kg
Lab Code:	K1704545-017	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	83	42-106	05/30/17	Acceptable
Fluoranthene-d10	93	45-109	05/30/17	Acceptable
Terphenyl-d14	100	41-102	05/30/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal tissue

Service Request: K1704545
Date Collected: 05/03/2017
Date Received: 05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name: MF-CRAB-05
Lab Code: K1704545-018

Units: ug/Kg
Basis: Wet

Extraction Method: EPA 3541
Analysis Method: 8270D SIM

Level: Low

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Phenanthrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	75	42-106	05/30/17	Acceptable
Fluoranthene-d10	80	45-109	05/30/17	Acceptable
Terphenyl-d14	91	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	FF-MUSSEL-01	**Units:**	ug/Kg
Lab Code:	K1704545-019	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Phenanthrene	**11**		5.0	1	05/25/17	05/30/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluoranthene	**11**		5.0	1	05/25/17	05/30/17	KWG1704280	
Pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	79	42-106	05/30/17	Acceptable
Fluoranthene-d10	81	45-109	05/30/17	Acceptable
Terphenyl-d14	87	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	FF-MUSSEL-02	**Units:**	ug/Kg
Lab Code:	K1704545-020	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Phenanthrene	**11**		5.0	1	05/25/17	05/30/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluoranthene	**13**		5.0	1	05/25/17	05/30/17	KWG1704280	
Pyrene	**5.2**		5.0	1	05/25/17	05/30/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	79	42-106	05/30/17	Acceptable
Fluoranthene-d10	81	45-109	05/30/17	Acceptable
Terphenyl-d14	88	41-102	05/30/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue		**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	FF-MUSSEL-03		**Units:**	ug/Kg
Lab Code:	K1704545-021		**Basis:**	Wet
Extraction Method:	EPA 3541		**Level:**	Low
Analysis Method:	8270D SIM			

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Phenanthrene	**11**		5.0	1	05/25/17	05/30/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluoranthene	**12**		5.0	1	05/25/17	05/30/17	KWG1704280	
Pyrene	**5.4**		5.0	1	05/25/17	05/30/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	78	42-106	05/30/17	Acceptable
Fluoranthene-d10	82	45-109	05/30/17	Acceptable
Terphenyl-d14	86	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	FF-MUSSEL-04	**Units:**	ug/Kg
Lab Code:	K1704545-022	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Phenanthrene	**12**		5.0	1	05/25/17	05/30/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluoranthene	**14**		5.0	1	05/25/17	05/30/17	KWG1704280	
Pyrene	**6.1**		5.0	1	05/25/17	05/30/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	72	42-106	05/30/17	Acceptable
Fluoranthene-d10	75	45-109	05/30/17	Acceptable
Terphenyl-d14	79	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue		**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	FF-MUSSEL-05		**Units:**	ug/Kg
Lab Code:	K1704545-023		**Basis:**	Wet
Extraction Method:	EPA 3541		**Level:**	Low
Analysis Method:	8270D SIM			

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Phenanthrene	**12**		5.0	1	05/25/17	05/31/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluoranthene	**16**		5.0	1	05/25/17	05/31/17	KWG1704280	
Pyrene	**6.8**		5.0	1	05/25/17	05/31/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	85	42-106	05/31/17	Acceptable
Fluoranthene-d10	89	45-109	05/31/17	Acceptable
Terphenyl-d14	90	41-102	05/31/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	REF-MUSSEL-01	**Units:**	ug/Kg
Lab Code:	K1704545-024	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Phenanthrene	**8.0**		5.0	1	05/25/17	05/31/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluoranthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	83	42-106	05/31/17	Acceptable
Fluoranthene-d10	86	45-109	05/31/17	Acceptable
Terphenyl-d14	92	41-102	05/31/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	REF-MUSSEL-02	**Units:**	ug/Kg
Lab Code:	K1704545-025	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Phenanthrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluoranthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	86	42-106	05/31/17	Acceptable
Fluoranthene-d10	88	45-109	05/31/17	Acceptable
Terphenyl-d14	92	41-102	05/31/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	REF-MUSSEL-03	**Units:**	ug/Kg
Lab Code:	K1704545-026	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Acenaphthylene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Acenaphthene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Dibenzofuran	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Fluorene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Phenanthrene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Anthracene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Fluoranthene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Pyrene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Benz(a)anthracene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Chrysene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.6	1	05/25/17	05/31/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	82	42-106	05/31/17	Acceptable
Fluoranthene-d10	87	45-109	05/31/17	Acceptable
Terphenyl-d14	89	41-102	05/31/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	REF-MUSSEL-04	**Units:**	ug/Kg
Lab Code:	K1704545-027	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
2-Methylnaphthalene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Acenaphthylene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Acenaphthene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Dibenzofuran	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Fluorene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Phenanthrene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Anthracene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Fluoranthene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Pyrene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Benz(a)anthracene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Chrysene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Benzo(a)pyrene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	6.1	1	05/25/17	05/31/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	85	42-106	05/31/17	Acceptable
Fluoranthene-d10	89	45-109	05/31/17	Acceptable
Terphenyl-d14	93	41-102	05/31/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	REF-MUSSEL-05	**Units:**	ug/Kg
Lab Code:	K1704545-028	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Phenanthrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	82	42-106	05/30/17	Acceptable
Fluoranthene-d10	84	45-109	05/30/17	Acceptable
Terphenyl-d14	88	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/04/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	REF-PRAWN-01	**Units:**	ug/Kg
Lab Code:	K1704545-029	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
2-Methylnaphthalene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Acenaphthylene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Acenaphthene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Dibenzofuran	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Fluorene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Phenanthrene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Anthracene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Fluoranthene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Pyrene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Benz(a)anthracene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Chrysene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Benzo(a)pyrene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	7.8	1	05/25/17	05/30/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	74	42-106	05/30/17	Acceptable
Fluoranthene-d10	80	45-109	05/30/17	Acceptable
Terphenyl-d14	88	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/05/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	REF-PRAWN-02	**Units:**	ug/Kg
Lab Code:	K1704545-030	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Phenanthrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	64	42-106	05/30/17	Acceptable
Fluoranthene-d10	68	45-109	05/30/17	Acceptable
Terphenyl-d14	72	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/05/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	REF-PRAWN-03	**Units:**	ug/Kg
Lab Code:	K1704545-031	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Phenanthrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	78	42-106	05/30/17	Acceptable
Fluoranthene-d10	81	45-109	05/30/17	Acceptable
Terphenyl-d14	89	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	REF-CRAB-01	**Units:**	ug/Kg
Lab Code:	K1704545-032	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Phenanthrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluoranthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	65	42-106	05/31/17	Acceptable
Fluoranthene-d10	73	45-109	05/31/17	Acceptable
Terphenyl-d14	83	41-102	05/31/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	04/29/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	REF-CRAB-02	**Units:**	ug/Kg
Lab Code:	K1704545-033	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Phenanthrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluoranthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	79	42-106	05/31/17	Acceptable
Fluoranthene-d10	86	45-109	05/31/17	Acceptable
Terphenyl-d14	91	41-102	05/31/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	05/05/2017
Sample Matrix:	Animal tissue	**Date Received:**	05/08/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	REF-CRAB-03	**Units:**	ug/Kg
Lab Code:	K1704545-034	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Phenanthrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Fluoranthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/31/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	74	42-106	05/31/17	Acceptable
Fluoranthene-d10	78	45-109	05/31/17	Acceptable
Terphenyl-d14	89	41-102	05/31/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal tissue

Service Request: K1704545
Date Collected: NA
Date Received: NA

Polynuclear Aromatic Hydrocarbons

Sample Name: Method Blank
Lab Code: KWG1704277-5
Extraction Method: EPA 3541
Analysis Method: 8270D SIM

Units: ug/Kg
Basis: Wet
Level: Low

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
2-Methylnaphthalene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Acenaphthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenzofuran	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluorene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Phenanthrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benz(a)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Chrysene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(k)fluoranthene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(a)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/24/17	05/30/17	KWG1704277	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	58	42-106	05/30/17	Acceptable
Fluoranthene-d10	76	45-109	05/30/17	Acceptable
Terphenyl-d14	84	41-102	05/30/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
Sample Matrix:	Animal tissue	**Date Received:**	NA

Polynuclear Aromatic Hydrocarbons

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG1704280-5	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
2-Methylnaphthalene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Acenaphthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenzofuran	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluorene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Phenanthrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benz(a)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Chrysene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(b)fluoranthene†	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(k)fluoranthene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(a)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Dibenz(a,h)anthracene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	
Benzo(g,h,i)perylene	ND	U	5.0	1	05/25/17	05/30/17	KWG1704280	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	62	42-106	05/30/17	Acceptable
Fluoranthene-d10	66	45-109	05/30/17	Acceptable
Terphenyl-d14	76	41-102	05/30/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		
Sample Matrix:	Animal tissue		

Surrogate Recovery Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method:	EPA 3541	**Units:**	Percent
Analysis Method:	8270D SIM	**Level:**	Low

Sample Name	Lab Code	Sur1	Sur2	Sur3
NF-PRAWN-01	K1704545-001	80	84	87
NF-PRAWN-02	K1704545-002	70	72	78
NF-PRAWN-03	K1704545-003	66	72	79
NF-PRAWN-04	K1704545-004	70	73	81
NF-PRAWN-05	K1704545-005	68	72	81
NF-MUSSEL-01	K1704545-006	69	72	77
NF-MUSSEL-02	K1704545-007	73	75	78
NF-MUSSEL-03	K1704545-008	72	75	79
NF-MUSSEL-04	K1704545-009	67	72	77
NF-MUSSEL-05	K1704545-010	77	82	85
NF-CRAB-01	K1704545-011	70	76	83
NF-CRAB-02	K1704545-012	72	75	83
NF-CRAB-03	K1704545-013	71	75	83
MF-CRAB-01	K1704545-014	70	72	78
MF-CRAB-02	K1704545-015	62	66	73
MF-CRAB-03	K1704545-016	67	75	83
MF-CRAB-04	K1704545-017	83	93	100
MF-CRAB-05	K1704545-018	75	80	91
FF-MUSSEL-01	K1704545-019	79	81	87
FF-MUSSEL-02	K1704545-020	79	81	88
FF-MUSSEL-03	K1704545-021	78	82	86
FF-MUSSEL-04	K1704545-022	72	75	79
FF-MUSSEL-05	K1704545-023	85	89	90
REF-MUSSEL-01	K1704545-024	83	86	92
REF-MUSSEL-02	K1704545-025	86	88	92
REF-MUSSEL-03	K1704545-026	82	87	89
REF-MUSSEL-04	K1704545-027	85	89	93
REF-MUSSEL-05	K1704545-028	82	84	88
REF-PRAWN-01	K1704545-029	74	80	88
REF-PRAWN-02	K1704545-030	64	68	72
REF-PRAWN-03	K1704545-031	78	81	89
REF-CRAB-01	K1704545-032	65	73	83
REF-CRAB-02	K1704545-033	79	86	91
REF-CRAB-03	K1704545-034	74	78	89

Surrogate Recovery Control Limits (%)

Sur1	=	Fluorene-d10	42-106
Sur2	=	Fluoranthene-d10	45-109
Sur3	=	Terphenyl-d14	41-102

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

QA/QC Report

Client: Golder Associates, Inc. **Service Request:** K1704545
Project: Skagway Tissue/1657231
Sample Matrix: Animal tissue

Surrogate Recovery Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3541 **Units:** Percent
Analysis Method: 8270D SIM **Level:** Low

Sample Name	Lab Code	Sur1	Sur2	Sur3
Method Blank	KWG1704277-5	58	76	84
Method Blank	KWG1704280-5	62	66	76
NF-CRAB-01MS	KWG1704277-1	77	84	88
NF-CRAB-01DMS	KWG1704277-2	72	79	83
MF-CRAB-05MS	KWG1704280-1	78	86	90
MF-CRAB-05DMS	KWG1704280-2	69	76	81
Lab Control Sample	KWG1704277-3	67	73	82
Duplicate Lab Control Sample	KWG1704277-4	66	76	86
Lab Control Sample	KWG1704280-3	78	85	92
Duplicate Lab Control Sample	KWG1704280-4	65	76	83

Surrogate Recovery Control Limits (%)

Sur1	=	Fluorene-d10	42-106
Sur2	=	Fluoranthene-d10	45-109
Sur3	=	Terphenyl-d14	41-102

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Extracted:**	05/24/2017
Sample Matrix:	Animal tissue	**Date Analyzed:**	05/30/2017

Matrix Spike/Duplicate Matrix Spike Summary
Polynuclear Aromatic Hydrocarbons

Sample Name:	NF-CRAB-01	**Units:**	ug/Kg
Lab Code:	K1704545-011	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM	**Extraction Lot:**	KWG1704277

		NF-CRAB-01MS KWG1704277-1 **Matrix Spike**			NF-CRAB-01DMS KWG1704277-2 **Duplicate Matrix Spike**					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	ND	312	497	63	299	496	60	37-104	4	40
2-Methylnaphthalene	ND	311	497	63	298	496	60	39-115	4	40
Acenaphthylene	ND	351	497	71	339	496	68	39-115	4	40
Acenaphthene	ND	353	497	71	335	496	68	41-116	5	40
Dibenzofuran	ND	368	497	74	347	496	70	41-121	6	40
Fluorene	ND	396	497	80	370	496	75	43-117	7	40
Phenanthrene	ND	389	497	78	363	496	73	42-119	7	40
Anthracene	ND	393	497	79	361	496	73	42-124	8	40
Fluoranthene	ND	415	497	84	386	496	78	42-130	7	40
Pyrene	ND	455	497	92	420	496	85	33-125	8	40
Benz(a)anthracene	ND	426	497	86	390	496	79	42-123	9	40
Chrysene	ND	430	497	87	396	496	80	40-134	8	40
Benzo(b)fluoranthene	ND	433	497	87	405	496	82	27-139	7	40
Benzo(k)fluoranthene	ND	407	497	82	376	496	76	40-125	8	40
Benzo(a)pyrene	ND	402	497	81	369	496	74	39-130	9	40
Indeno(1,2,3-cd)pyrene	ND	403	497	81	368	496	74	37-143	9	40
Dibenz(a,h)anthracene	ND	361	497	73	336	496	68	39-141	7	40
Benzo(g,h,i)perylene	ND	424	497	85	389	496	78	35-140	9	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Extracted:**	05/25/2017
Sample Matrix:	Animal tissue	**Date Analyzed:**	05/30/2017

Matrix Spike/Duplicate Matrix Spike Summary
Polynuclear Aromatic Hydrocarbons

Sample Name:	MF-CRAB-05	**Units:**	ug/Kg
Lab Code:	K1704545-018	**Basis:**	Wet
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM	**Extraction Lot:**	KWG1704280

		MF-CRAB-05MS KWG1704280-1 Matrix Spike			MF-CRAB-05DMS KWG1704280-2 Duplicate Matrix Spike					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	ND	307	499	62	258	496	52	37-104	18	40
2-Methylnaphthalene	ND	303	499	61	257	496	52	39-115	17	40
Acenaphthylene	ND	347	499	70	297	496	60	39-115	15	40
Acenaphthene	ND	348	499	70	295	496	59	41-116	16	40
Dibenzofuran	ND	358	499	72	305	496	62	41-121	16	40
Fluorene	ND	383	499	77	328	496	66	43-117	15	40
Phenanthrene	ND	381	499	76	326	496	66	42-119	16	40
Anthracene	ND	384	499	77	326	496	66	42-124	16	40
Fluoranthene	ND	406	499	81	350	496	70	42-130	15	40
Pyrene	ND	430	499	86	371	496	75	33-125	15	40
Benz(a)anthracene	ND	416	499	83	357	496	72	42-123	15	40
Chrysene	ND	421	499	84	361	496	73	40-134	15	40
Benzo(b)fluoranthene	ND	430	499	86	365	496	74	27-139	16	40
Benzo(k)fluoranthene	ND	408	499	82	347	496	70	40-125	16	40
Benzo(a)pyrene	ND	397	499	80	336	496	68	39-130	17	40
Indeno(1,2,3-cd)pyrene	ND	376	499	75	315	496	63	37-143	18	40
Dibenz(a,h)anthracene	ND	328	499	66	265	496	53	39-141	21	40
Benzo(g,h,i)perylene	ND	402	499	81	340	496	68	35-140	17	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

QA/QC Report

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal tissue

Service Request: K1704545
Date Extracted: 05/24/2017
Date Analyzed: 05/30/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3541
Analysis Method: 8270D SIM

Units: ug/Kg
Basis: Wet
Level: Low
Extraction Lot: KWG1704277

	Lab Control Sample KWG1704277-3 **Lab Control Spike**			Duplicate Lab Control Sample KWG1704277-4 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	291	500	58	270	500	54	42-107	8	40
2-Methylnaphthalene	287	500	57	268	500	54	40-116	7	40
Acenaphthylene	312	500	62	290	500	58	41-112	7	40
Acenaphthene	308	500	62	290	500	58	43-113	6	40
Dibenzofuran	318	500	64	300	500	60	43-114	6	40
Fluorene	327	500	65	313	500	63	44-114	4	40
Phenanthrene	323	500	65	307	500	61	44-115	5	40
Anthracene	328	500	66	315	500	63	45-121	4	40
Fluoranthene	356	500	71	349	500	70	47-123	2	40
Pyrene	395	500	79	390	500	78	41-121	1	40
Benz(a)anthracene	386	500	77	377	500	75	42-123	2	40
Chrysene	392	500	78	385	500	77	46-130	2	40
Benzo(b)fluoranthene	403	500	81	404	500	81	46-125	0	40
Benzo(k)fluoranthene	387	500	77	377	500	75	47-125	3	40
Benzo(a)pyrene	371	500	74	358	500	72	45-128	3	40
Indeno(1,2,3-cd)pyrene	363	500	73	335	500	67	45-128	8	40
Dibenz(a,h)anthracene	316	500	63	270	500	54	44-128	16	40
Benzo(g,h,i)perylene	381	500	76	363	500	73	43-125	5	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Animal tissue

Service Request: K1704545
Date Extracted: 05/25/2017
Date Analyzed: 05/30/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3541
Analysis Method: 8270D SIM

Units: ug/Kg
Basis: Wet
Level: Low
Extraction Lot: KWG1704280

	Lab Control Sample KWG1704280-3 **Lab Control Spike**			Duplicate Lab Control Sample KWG1704280-4 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	324	500	65	274	500	55	42-107	17	40
2-Methylnaphthalene	321	500	64	268	500	54	40-116	18	40
Acenaphthylene	362	500	72	304	500	61	41-112	17	40
Acenaphthene	361	500	72	304	500	61	43-113	17	40
Dibenzofuran	371	500	74	310	500	62	43-114	18	40
Fluorene	390	500	78	307	500	61	44-114	24	40
Phenanthrene	375	500	75	331	500	66	44-115	12	40
Anthracene	386	500	77	336	500	67	45-121	14	40
Fluoranthene	415	500	83	375	500	75	47-123	10	40
Pyrene	449	500	90	411	500	82	41-121	9	40
Benz(a)anthracene	444	500	89	400	500	80	42-123	10	40
Chrysene	450	500	90	406	500	81	46-130	10	40
Benzo(b)fluoranthene	458	500	92	419	500	84	46-125	9	40
Benzo(k)fluoranthene	440	500	88	401	500	80	47-125	9	40
Benzo(a)pyrene	426	500	85	380	500	76	45-128	11	40
Indeno(1,2,3-cd)pyrene	414	500	83	357	500	71	45-128	15	40
Dibenz(a,h)anthracene	349	500	70	284	500	57	44-128	20	40
Benzo(g,h,i)perylene	430	500	86	389	500	78	43-125	10	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Analytical Results

Client:	Golder Associates, Inc.		**Service Request:**	K1704545
Project:	Skagway Tissue/1657231		**Date Collected:**	05/15/2017
Sample Matrix:	Water		**Date Received:**	05/16/2017

Polynuclear Aromatic Hydrocarbons

Sample Name:	Homog. Blank		**Units:**	ug/L
Lab Code:	K1704545-035		**Basis:**	NA
Extraction Method:	EPA 3520C		**Level:**	Low
Analysis Method:	8270D SIM			

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
2-Methylnaphthalene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Acenaphthylene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Acenaphthene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Dibenzofuran	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Fluorene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Phenanthrene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Anthracene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Fluoranthene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Pyrene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Benz(a)anthracene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Chrysene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Benzo(b)fluoranthene†	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Benzo(k)fluoranthene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Benzo(a)pyrene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Indeno(1,2,3-cd)pyrene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Dibenz(a,h)anthracene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Benzo(g,h,i)perylene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	104	42-131	05/25/17	Acceptable
Fluoranthene-d10	121	42-133	05/25/17	Acceptable
Terphenyl-d14	103	32-129	05/25/17	Acceptable

† **Analyte Comments**

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

Analytical Results

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA

Polynuclear Aromatic Hydrocarbons

Sample Name:	Method Blank	**Units:**	ug/L
Lab Code:	KWG1704109-3	**Basis:**	NA
Extraction Method:	EPA 3520C	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
2-Methylnaphthalene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Acenaphthylene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Acenaphthene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Dibenzofuran	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Fluorene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Phenanthrene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Anthracene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Fluoranthene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Pyrene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Benz(a)anthracene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Chrysene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Benzo(b)fluoranthene†	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Benzo(k)fluoranthene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Benzo(a)pyrene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Indeno(1,2,3-cd)pyrene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Dibenz(a,h)anthracene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	
Benzo(g,h,i)perylene	ND	U	0.019	1	05/22/17	05/25/17	KWG1704109	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	97	42-131	05/25/17	Acceptable
Fluoranthene-d10	115	42-133	05/25/17	Acceptable
Terphenyl-d14	101	32-129	05/25/17	Acceptable

† Analyte Comments

Benzo(b)fluoranthene	This analyte cannot be separated from Benzo(j)fluoranthene.

Comments:

QA/QC Report

Client: Golder Associates, Inc.
Project: Skagway Tissue/1657231
Sample Matrix: Water

Service Request: K1704545

Surrogate Recovery Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3520C
Analysis Method: 8270D SIM

Units: Percent
Level: Low

Sample Name	Lab Code	Sur1	Sur2	Sur3
Homog. Blank	K1704545-035	104	121	103
Method Blank	KWG1704109-3	97	115	101
Lab Control Sample	KWG1704109-1	100	118	106
Duplicate Lab Control Sample	KWG1704109-2	95	113	101

Surrogate Recovery Control Limits (%)

Sur1	=	Fluorene-d10	42-131
Sur2	=	Fluoranthene-d10	42-133
Sur3	=	Terphenyl-d14	32-129

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

QA/QC Report

Client:	Golder Associates, Inc.	**Service Request:**	K1704545
Project:	Skagway Tissue/1657231	**Date Extracted:**	05/22/2017
Sample Matrix:	Water	**Date Analyzed:**	05/25/2017

Lab Control Spike/Duplicate Lab Control Spike Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method:	EPA 3520C	**Units:**	ug/L
Analysis Method:	8270D SIM	**Basis:**	NA
		Level:	Low
		Extraction Lot:	KWG1704109

	Lab Control Sample KWG1704109-1 **Lab Control Spike**			Duplicate Lab Control Sample KWG1704109-2 **Duplicate Lab Control Spike**					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	1.86	2.50	74	1.81	2.50	72	52-115	3	30
2-Methylnaphthalene	1.97	2.50	79	1.93	2.50	77	48-120	2	30
Acenaphthylene	2.30	2.50	92	2.23	2.50	89	58-124	3	30
Acenaphthene	2.12	2.50	85	2.06	2.50	82	63-121	3	30
Dibenzofuran	2.32	2.50	93	2.28	2.50	91	56-132	2	30
Fluorene	2.29	2.50	91	2.23	2.50	89	68-121	3	30
Phenanthrene	2.45	2.50	98	2.42	2.50	97	64-126	1	30
Anthracene	1.97	2.50	79	2.00	2.50	80	68-127	2	30
Fluoranthene	2.25	2.50	90	2.24	2.50	90	70-127	1	30
Pyrene	2.30	2.50	92	2.27	2.50	91	72-127	1	30
Benz(a)anthracene	2.42	2.50	97	2.40	2.50	96	74-124	1	30
Chrysene	2.27	2.50	91	2.26	2.50	90	74-132	1	30
Benzo(b)fluoranthene	2.40	2.50	96	2.41	2.50	96	73-136	0	30
Benzo(k)fluoranthene	2.37	2.50	95	2.40	2.50	96	74-134	1	30
Benzo(a)pyrene	2.33	2.50	93	2.31	2.50	93	75-131	1	30
Indeno(1,2,3-cd)pyrene	2.51	2.50	100	2.46	2.50	98	63-136	2	30
Dibenz(a,h)anthracene	2.31	2.50	93	2.30	2.50	92	59-135	1	30
Benzo(g,h,i)perylene	2.30	2.50	92	2.28	2.50	91	63-127	1	30

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

APPENDIX E

Final Toxicity Reports

Echinoderm Larval Development Sediment Test Summary Sheet

Client: Golder
Work Order No.: 170469

Start Date: May 26, 2017
Set up by: YYL

Sample Information:

Sample ID: Various - see below
Sample Date: April 26, 29 & 30; May 1, 2, 4 & 5, 2017
Date Received: May 15, 2017
Sample Volume: 2 x 4L per sample

Test Organism Information:

Species: Strongylocentrotus purpuratus
Supplier: Nautilus - San Diego
Date received: May 26, 2017

Copper Reference Toxicant Results:

Reference Toxicant ID: SpD17
Stock Solution ID: 17Cu01
Date Initiated: May 26, 2017

48-h EC50 Normal Larvae (95% CL): 17.3 (16.8 - 17.9) µg/L Cu

48-h EC50 Normal Larvae Reference Toxicant Mean ± 2 SD: 22.4 (14.6 - 34.3) µg/L Cu CV (%): 24

Test Results:

Sample ID	Survival ± SD (%)	Normal Larvae ± SD (%)	Combined Proportion Normal ± SD (%)
Control SW	86.5 ± 4.4	82.8 ± 1.5	71.6 ± 3.7
SED17-08	65.4 ± 5.3 (*)	0.8 ± 0.7 (*)(a)(b)(c)	0.5 ± 0.4 (*)(a)(b)(c)
SED17-06	77.6 ± 3.9	79.5 ± 2.3 (c)	61.8 ± 4.3 (*)
SED17-09	7.3 ± 6.6 (*)(a)(c)	42.6 ± 39.2 (*)(a)(c)	2.6 ± 3.2 (*)(a)(c)
SED17-13	1.7 ± 0.7 (*)(a)(b)(c)	3.3 ± 7.5 (*)(a)(b)(c)	0.1 ± 0.2 (*)(a)(b)(c)
SED17-17	75.3 ± 10.1	83.7 ± 6.2	62.8 ± 7.8
SED17-20	2.4 ± 1.0 (*)(a)(b)(c)	13.3 ± 29.8 (*)(a)(c)	0.4 ± 1.0 (*)(a)(b)(c)
SED17-18	31.0 ± 17.4 (*)(a)(c)	70.6 ± 16.9 (c)	23.3 ± 16.2 (*)(a)(c)
SED17-19	14.1 ± 9.9 (*)(a)(c)	25.8 ± 29.5 (*)(a)(c)	5.8 ± 8.6 (*)(a)(c)
SED17-24 (RS)	81.8 ± 9.9	83.5 ± 2.7	68.3 ± 8.5
SED17-12	56.6 ~~56.7~~ ± 10.5 (*)(a)	0.1 ± 0.3 (*)(a)(b)(c)	0.1 ± 0.2 (*)(a)(b)(c)
SED17-01	84.4 ± 3.5	83.4 ± 6.0	70.6 ± 7.4
SED17-03	24.4 ± 9.1 (*)(a)(c)	80.6 ± 3.1 (c)	19.6 ± 7.5 (*)(a)(c)
SED17-29 (RS)	20.5 ± 18.6 (*)(a)(c)	67.4 ± 16.8	15.9 ± 17.7 (*)(a)(c)
SED17-27 (RS)	74.9 ± 4.2 (*)	87.9 ± 2.0	65.8 ± 3.9

(RS) = Reference sediment

(*) Indicates a significant effect relative to Control SW
(a) Indicates a significant effect relative to reference sediment SED17-24
(b) Indicates a significant effect relative to reference sediment SED17-29
(c) Indicates a significant effect relative to reference sediment SED17-27

Reviewed by: [signature]

Date reviewed: July 24, 2017

Echinoderm Larvae Development Toxicity Test Data Sheet - Larval Counts

Client: Golder

Work Order #: 170469

Test set up by: YYL

Start Date/Time: May 26, 2017 @ 1555h

End Date/Time: May 30, 2017 @ 1625h

Test species: S. purpuratus

Initial Density/ 10 mL aliquot: 275

Sample ID	Rep	No. Normal	No. Abnormal	Comments	Initials
Control SW	A	193	41		YYL
	B	200	35		
	C	187	44		
	D	191	39		
	E	213	46		
SED17-08	A	0	176		
	B	3	169		
	C	2	163		
	D	1	202		
	E	1	183		
SED17-06	A	173	41		
	B	173	38		
	C	184	46		
	D	167	45		
	E	152	48		
SED17-09	A	6	5		
	B	0	4		
	C	7	2		
	D	22	6	2nd count: 20/7 ①	
	E	1	47	2nd count: 1/48 ①	
SED17-13	A	1	5		
	B	0	4		
	C	0	7		
	D	0	4		
	E	0	2		
SED17-17	A	167	50		
	B	176	51		
	C	208	27		
	D	154	16		
	E	158	28		
SED17-20	A	6	3		
	B	0	3		
	C	0	5		
	D	0	6		
	E	0	10		

① 2nd count w/in 10% of 1st count, therefore 1st count used for statistics.

Reviewed by: [signature] Date Reviewed: July 21, 2017

Echinoderm Larvae Development Toxicity Test Data Sheet - Larval Counts

Client: Golder
Work Order #: 170469
Test set up by: YuL
Start Date/Time: May 26, 2017 @ 1555h
End Date/Time: May 30, 2017 @ 1625h
Test species: S. purpuratus
Initial Density/ 10 mL aliquot: 275

Sample ID	Rep	No. Normal	No. Abnormal	Comments	Initials
SED17-18	A	28	33	2nd count: 26/34 ①	YuL
	B	60	12		
	C	21	14	2nd count: 19/16 ①	
	D	80	17		
	E	131	30	2nd count: 125/31 ①	
SED17-19	A	12	23		
	B	11	36		
	C	0	24		
	D	0	8		
	E	57	23	2nd count: 64/22 ①	
SED17-24	A	199	41		
	B	184	26		
	C	222	43		
	D	170	42		
	E	164	34		
~~SE17~~ SED17-12	A	0	137		
	B	0	174		
	C	0	196	2nd count: 0/199 ①	
	D	0	125		
	E	1	146		
SED17-01	A	207	37		
	B	209	25		
	C	160	57		
	D	203	30		
	E	191	42		
SED17-03	A	31	6	2nd count: 34/5 ①	
	B	65	14		
	C	44	14		
	D	46	12		
	E	84	19	2nd count: 82/19 ①	
SED17-29	A	10	10		
	B	23	13		
	C	43	10		
	D	15	13		
	E	128	17	2nd count: 134/16 ①	

① 2nd count w/in 10% of 1st count, therefore 1st count used for statistics.

Reviewed by: [signature] Date Reviewed: July 21, 2017

Echinoderm Larvae Development Toxicity Test Data Sheet - Larval Counts

Client: Golder
Start Date/Time: May 26, 2017 @ 1555h
Work Order #: 170469
End Date/Time: May 30, 2017 @ 1625h
Test set up by: YML
Test species: S. purpuratus
Initial Density/ 10 mL aliquot: 275

Sample ID	Rep	No. Normal	No. Abnormal	Comments	Initials
SED17-27	A	187	26		YML
	B	163	24		↓
	C	187	18		
	D	189	28		
	E	179	29		
	A				
	B				
	C				
	D				
	E				
	A				
	B				
	C				
	D				
	E				
	A				
	B				
	C				
	D				
	E				
	A				
	B				
	C				
	D				
	E				
	A				
	B				
	C				
	D				
	E				
	A				
	B				
	C				
	D				
	E				

Reviewed by: [signature]
Date Reviewed: July 21, 2017

Echinoderm Development Toxicity Test Data Sheet

Client: Golder
Sample ID: Various
Work Order No.: 170469

Start Date & Time: May 26, 2017 @ ~~1430h~~ 1555h
End Date & Time: May 30, 2017 @ 1625h
Test species: S. purpuratus

Sample ID	Temperature (°C) 0	24	48	72	96	Dissolved oxygen (mg/L) 0	24	48	72	96	pH (units) 0	24	48	72	96	Salinity (ppt) 0	24	48	72	96
Control SW	15.0	14.5	14.5	15.0	15.0	8.1	8.1	7.9	7.7	7.8	7.7	7.7	7.6	7.6	7.5	27				27
SED17-08	15.0	14.5	14.5	15.0	15.0	7.4	7.8	7.9	7.5	6.8	7.7	7.8	7.7	7.5	7.4	27				27
SED17-06	15.0	14.5	14.5	15.0	15.0	7.4	7.6	7.7	7.3	7.4	7.6	7.7	7.6	7.5	7.4	27				27
SED17-09	15.0	14.5	14.5	15.0	15.0	7.2	7.7	7.6	7.3	7.3	7.7	7.7	7.7	7.5	7.4	27				27
SED17-13	15.0	14.5	14.5	15.0	15.0	7.1	7.6	7.6	7.0	6.8	7.7	7.7	7.7	7.4	7.3	27				27
SED17-17	15.0	14.5	14.5	15.0	15.0	7.2	7.6	7.5	7.2	7.4	7.6	7.6	7.7	7.5	7.4	27				27
SED17-20	15.0	14.5	14.5	15.0	15.0	6.4	7.5	7.6	7.0	7.4	7.6	7.7	7.6	7.5	7.5	27				27
SED17-18	15.0	14.5	14.5	15.0	15.0	6.7	7.5	7.5	7.3	7.3	7.6	7.7	7.7	7.5	7.4	27				27
SED17-19	15.0	14.5	14.5	15.0	15.0	6.8	7.4	7.5	7.4	6.6	7.7	7.6	7.7	7.4	7.3	27				27
SED17-24	15.0	14.5	14.5	15.0	15.0	7.2	7.5	7.6	7.5	7.5	7.7	7.7	7.7	7.5	7.4	27				27
SED17-12	15.0	14.5	14.5	15.0	15.0	7.3	7.5	7.4	7.5	7.3	7.7	7.7	7.6	7.5	7.3	27				27
SED17-01	15.0	14.5	14.5	15.0	15.0	7.2	7.6	7.5	7.2	7.3	7.6	7.7	7.7	7.5	7.3	27				27
SED17-03	15.0	14.5	14.5	15.0	15.0	7.2	7.4	7.5	7.0	7.3	7.6	7.7	7.7	7.6	7.4	27				27
SED17-29	15.0	14.5	14.5	15.0	15.0	7.0	7.5	7.4	7.3	7.4	7.7	7.7	7.7	7.5	7.3	27				27
SED17-27	15.0	14.5	14.5	15.0	15.0	7.2	7.5	7.4	7.3	7.6	7.6	7.7	7.6	7.6	7.4	27				27
Analyst Initials	YHL	[illegible]	[illegible]	YHL	YHL	YHL	[illegible]	[illegible]	YHL	YHL	YHL	[illegible]	[illegible]	YHL	YHL	YHL				YHL

Test Set up by: YHL

Comments:

Reviewed by: [illegible signature]

Date Reviewed: July 21 2017

Echinoderm Larvae Development Toxicity Sediment Weight Data Sheet

Client: Golder
Work Order #: 170469
Test set up by: YYL

Start Date/Time: May 26, 2017 @ 1555h
End Date/Time: May 30, 2017 @ 1625
Test species: S. purpuratus

Sample ID	Rep	Weight (g)	Initials	Sample ID	Rep	Weight (g)	Initials
SED17-08	A	17.98	YYL	SED17-24	A	18.03	YYL
	B	18.17			B	18.10	
	C	17.91			C	17.83	
	D	18.05			D	17.97	
	E	18.00			E	18.00	
SED17-06	A	18.19		SED17-12	A	18.19	
	B	18.04			B	18.05	
	C	17.83			C	18.09	
	D	17.89			D	17.82	
	E	18.20			E	17.89	
SED17-09	A	18.10		SED17-01	A	18.21	
	B	17.97			B	18.01	
	C	18.23			C	17.97	
	D	18.11			D	17.81	
	E	17.92			E	17.95	
SED17-13	A	18.25		SED17-03	A	17.91	
	B	17.98			B	18.20	
	C	17.95			C	18.15	
	D	18.00			D	17.83	
	E	18.05			E	17.98	
SED17-17	A	18.03		SED17-29	A	17.93	
	B	18.04			B	18.09	
	C	18.19			C	18.12	
	D	18.25			D	17.80	
	E	17.98			E	17.86	
SED17-20	A	17.90		SED17-27	A	17.83	
	B	18.03			B	18.16	
	C	18.22			C	18.01	
	D	18.12			D	17.94	
	E	17.97			E	17.91	
SED17-18	A	17.83			A		
	B	18.12			B		
	C	18.04			C		
	D	18.09			D		
	E	17.86			E		
SED17-19	A	17.96			A		
	B	18.17			B		
	C	17.83			C		
	D	18.13			D		
	E	18.18			E		

Comments:

Reviewed by: [signature]

Date Reviewed: July 21, 2017

Randomization Chart - Echinoderm Larvae Development Toxicity Test

Client: Golder

WO#: 170469

Start Date/Time: May 26, 2017 @ 1555h

End Date/Time: May 30, 2017 @ 1625h

27 B	12 C	20 A	13 B	29 C	24 A	09 B	01 A	24 E	Cont SW D	19 E	09 A	06 D	08 B	13 C
17 B	08 A	09 E	03 A	12 D	01 E	27 A	08 C	17 E	29 D	18 E	19 B	12 B	13 D	24 D
06 C	01 C	Cont SW E	18 C	Cont SW B	20 E	06 E	27 E	27 C	01 D	09 C	17 D	Cont SW C	20 C	06 A
12 E	18 B	19 A	24 C	19 D	03 D	29 B	17 C	29 A	03 E	08 E	13 A	20 B	18 A	03 B
Cont SW A	08 D	06 B	09 D	13 E	17 A	20 D	18 D	19 C	24 B	12 A	01 B	03 C	29 E	27 D

EJ

July 21, 2017

CETIS Summary Report

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Batch ID:	08-3704-4652	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control SW	19-4378-7830	25 May-17	25 May-17	40h	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2867	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control SW	Control SW	Golder	Control Seawater		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Combined Proportion Normal Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control SW	5	0.7156	0.6695	0.7617	0.68	0.7745	0.0166	0.03712	5.19%	0.0%
SED17-08	5	0.005091	0	0.01024	0	0.01091	0.001854	0.004146	81.44%	99.29%
SED17-06	5	0.6175	0.5647	0.6702	0.5527	0.6691	0.01901	0.04252	6.89%	13.72%
SED17-09	5	0.02618	0	0.06598	0	0.08	0.01433	0.03205	122.4%	96.34%
SED17-13	5	0.0007273	0	0.002747	0	0.003636	0.0007273	0.001626	223.6%	99.9%
SED17-17	5	0.6276	0.5304	0.7249	0.56	0.7564	0.03502	0.07831	12.48%	12.3%
SED17-20	5	0.004364	0	0.01648	0	0.02182	0.004364	0.009757	223.6%	99.39%
SED17-18	5	0.2327	0.03199	0.4335	0.07636	0.4764	0.0723	0.1617	69.47%	67.48%
SED17-19	5	0.05818	0	0.1649	0	0.2073	0.03843	0.08594	147.7%	91.87%
SED17-24	5	0.6829	0.5772	0.7886	0.5964	0.8073	0.03808	0.08514	12.47%	4.57%
SED17-12	5	0.0007273	0	0.002747	0	0.003636	0.0007273	0.001626	223.6%	99.9%
SED17-01	5	0.7055	0.614	0.7969	0.5818	0.76	0.03293	0.07363	10.44%	1.42%
SED17-03	5	0.1964	0.1029	0.2898	0.1127	0.3055	0.03366	0.07527	38.33%	72.56%
SED17-29	5	0.1593	0	0.3793	0.03636	0.4655	0.07923	0.1772	111.2%	77.74%
SED17-27	5	0.6582	0.6096	0.7068	0.5927	0.6873	0.01752	0.03916	5.95%	8.03%

Proportion Normal Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control SW	5	0.8276	0.8088	0.8465	0.8095	0.8511	0.006784	0.01517	1.83%	0.0%
SED17-08	5	0.007985	0	0.01646	0	0.01744	0.003051	0.006822	85.44%	99.04%
SED17-06	5	0.7952	0.7667	0.8237	0.76	0.8199	0.01025	0.02293	2.88%	3.92%
SED17-09	5	0.426	0	0.9121	0	0.7857	0.1751	0.3915	91.91%	48.53%
SED17-13	5	0.03333	0	0.1259	0	0.1667	0.03333	0.07454	223.6%	95.97%
SED17-17	5	0.8371	0.7596	0.9145	0.7696	0.9059	0.02789	0.06237	7.45%	-1.14%
SED17-20	5	0.1333	0	0.5035	0	0.6667	0.1333	0.2981	223.6%	83.89%
SED17-18	5	0.7062	0.4964	0.9159	0.459	0.8333	0.07555	0.1689	23.92%	14.68%
SED17-19	5	0.2579	0	0.6238	0	0.7125	0.1318	0.2947	114.3%	68.84%
SED17-24	5	0.8347	0.8013	0.868	0.8019	0.8762	0.012	0.02683	3.21%	-0.85%
SED17-12	5	0.001361	0	0.005138	0	0.006803	0.001361	0.003042	223.6%	99.84%
SED17-01	5	0.834	0.7588	0.9091	0.7373	0.8932	0.02706	0.0605	7.26%	-0.76%
SED17-03	5	0.8056	0.7673	0.8438	0.7586	0.8378	0.01378	0.03081	3.82%	2.67%
SED17-29	5	0.6737	0.465	0.8825	0.5	0.8828	0.07519	0.1681	24.95%	18.6%
SED17-27	5	0.8787	0.8541	0.9032	0.8606	0.9122	0.008833	0.01975	2.25%	-6.17%

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control SW	5	0.8647	0.8104	0.919	0.8364	0.9418	0.01956	0.04374	5.06%	0.0%
SED17-08	5	0.6545	0.5887	0.7204	0.6	0.7382	0.02371	0.05301	8.1%	24.31%
SED17-06	5	0.776	0.7274	0.8246	0.7273	0.8364	0.0175	0.03913	5.04%	10.26%
SED17-09	5	0.07273	0	0.1543	0.01455	0.1745	0.02938	0.06571	90.35%	91.59%
SED17-13	5	0.01673	0.007926	0.02553	0.007273	0.02545	0.00317	0.007089	42.38%	98.07%
SED17-17	5	0.7527	0.6272	0.8783	0.6182	0.8545	0.04523	0.1011	13.44%	12.95%
SED17-20	5	0.024	0.01099	0.03701	0.01091	0.03636	0.004685	0.01048	43.65%	97.22%
SED17-18	5	0.3098	0.09369	0.5259	0.1273	0.5855	0.07784	0.1741	56.18%	64.17%
SED17-19	5	0.1411	0.01854	0.2636	0.02909	0.2909	0.04414	0.0987	69.95%	83.68%
SED17-24	5	0.8182	0.6956	0.9408	0.72	0.9636	0.04415	0.09872	12.07%	5.38%
SED17-12	5	0.5665	0.4363	0.6968	0.4545	0.7127	0.0469	0.1049	18.51%	34.48%
SED17-01	5	0.8444	0.8007	0.8881	0.7891	0.8873	0.01574	0.0352	4.17%	2.36%
SED17-03	5	0.2436	0.1307	0.3566	0.1345	0.3745	0.04067	0.09095	37.33%	71.83%
SED17-29	5	0.2051	0	0.4354	0.07273	0.5273	0.08296	0.1855	90.45%	76.28%
SED17-27	5	0.7491	0.6968	0.8014	0.68	0.7891	0.01882	0.04209	5.62%	13.37%

Combined Proportion Normal Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	0.7018	0.7273	0.68	0.6945	0.7745
SED17-08	0	0.01091	0.007273	0.003636	0.003636
SED17-06	0.6291	0.6291	0.6691	0.6073	0.5527
SED17-09	0.02182	0	0.02545	0.08	0.003636
SED17-13	0.003636	0	0	0	0
SED17-17	0.6073	0.64	0.7564	0.56	0.5745
SED17-20	0.02182	0	0	0	0
SED17-18	0.1018	0.2182	0.07636	0.2909	0.4764
SED17-19	0.04364	0.04	0	0	0.2073
SED17-24	0.7236	0.6691	0.8073	0.6182	0.5964
SED17-12	0	0	0	0	0.003636
SED17-01	0.7527	0.76	0.5818	0.7382	0.6945
SED17-03	0.1127	0.2364	0.16	0.1673	0.3055
SED17-29	0.03636	0.08364	0.1564	0.05455	0.4655
SED17-27	0.68	0.5927	0.68	0.6873	0.6509

Proportion Normal Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	0.8248	0.8511	0.8095	0.8304	0.8224
SED17-08	0	0.01744	0.01212	0.004926	0.005435
SED17-06	0.8084	0.8199	0.8	0.7877	0.76
SED17-09	0.5455	0	0.7778	0.7857	0.02083
SED17-13	0.1667	0	0	0	0
SED17-17	0.7696	0.7753	0.8851	0.9059	0.8495
SED17-20	0.6667	0	0	0	0
SED17-18	0.459	0.8333	0.6	0.8247	0.8137
SED17-19	0.3429	0.234	0	0	0.7125
SED17-24	0.8292	0.8762	0.8377	0.8019	0.8283
SED17-12	0	0	0	0	0.006803
SED17-01	0.8484	0.8932	0.7373	0.8712	0.8197
SED17-03	0.8378	0.8228	0.7586	0.7931	0.8155
SED17-29	0.5	0.6389	0.8113	0.5357	0.8828
SED17-27	0.8779	0.8717	0.9122	0.871	0.8606

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	0.8509	0.8545	0.84	0.8364	0.9418
SED17-08	0.64	0.6255	0.6	0.7382	0.6691
SED17-06	0.7782	0.7673	0.8364	0.7709	0.7273
SED17-09	0.04	0.01455	0.03273	0.1018	0.1745
SED17-13	0.02182	0.01455	0.02545	0.01455	0.007273
SED17-17	0.7891	0.8255	0.8545	0.6182	0.6764
SED17-20	0.03273	0.01091	0.01818	0.02182	0.03636
SED17-18	0.2218	0.2618	0.1273	0.3527	0.5855
SED17-19	0.1273	0.1709	0.08727	0.02909	0.2909
SED17-24	0.8727	0.7636	0.9636	0.7709	0.72
SED17-12	0.4982	0.6327	0.7127	0.4545	0.5345
SED17-01	0.8873	0.8509	0.7891	0.8473	0.8473
SED17-03	0.1345	0.2873	0.2109	0.2109	0.3745
SED17-29	0.07273	0.1309	0.1927	0.1018	0.5273
SED17-27	0.7745	0.68	0.7455	0.7891	0.7564

Combined Proportion Normal Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	193/275	200/275	187/275	191/275	213/275
SED17-08	0/275	3/275	2/275	1/275	1/275
SED17-06	173/275	173/275	184/275	167/275	152/275
SED17-09	6/275	0/275	7/275	22/275	1/275
SED17-13	1/275	0/275	0/275	0/275	0/275
SED17-17	167/275	176/275	208/275	154/275	158/275
SED17-20	6/275	0/275	0/275	0/275	0/275
SED17-18	28/275	60/275	21/275	80/275	131/275
SED17-19	12/275	11/275	0/275	0/275	57/275
SED17-24	199/275	184/275	222/275	170/275	164/275
SED17-12	0/275	0/275	0/275	0/275	1/275
SED17-01	207/275	209/275	160/275	203/275	191/275
SED17-03	31/275	65/275	44/275	46/275	84/275
SED17-29	10/275	23/275	43/275	15/275	128/275
SED17-27	187/275	163/275	187/275	189/275	179/275

Proportion Normal Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	193/234	200/235	187/231	191/230	213/259
SED17-08	0/176	3/172	2/165	1/203	1/184
SED17-06	173/214	173/211	184/230	167/212	152/200
SED17-09	6/11	0/4	7/9	22/28	1/48
SED17-13	1/6	0/4	0/7	0/4	0/2
SED17-17	167/217	176/227	208/235	154/170	158/186
SED17-20	6/9	0/3	0/5	0/6	0/10
SED17-18	28/61	60/72	21/35	80/97	131/161
SED17-19	12/35	11/47	0/24	0/8	57/80
SED17-24	199/240	184/210	222/265	170/212	164/198
SED17-12	0/137	0/174	0/196	0/125	1/147
SED17-01	207/244	209/234	160/217	203/233	191/233
SED17-03	31/37	65/79	44/58	46/58	84/103
SED17-29	10/20	23/36	43/53	15/28	128/145
SED17-27	187/213	163/187	187/205	189/217	179/208

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	234/275	235/275	231/275	230/275	259/275
SED17-08	176/275	172/275	165/275	203/275	184/275
SED17-06	214/275	211/275	230/275	212/275	200/275
SED17-09	11/275	4/275	9/275	28/275	48/275
SED17-13	6/275	4/275	7/275	4/275	2/275
SED17-17	217/275	227/275	235/275	170/275	186/275
SED17-20	9/275	3/275	5/275	6/275	10/275
SED17-18	61/275	72/275	35/275	97/275	161/275
SED17-19	35/275	47/275	24/275	8/275	80/275
SED17-24	240/275	210/275	265/275	212/275	198/275
SED17-12	137/275	174/275	196/275	125/275	147/275
SED17-01	244/275	234/275	217/275	233/275	233/275
SED17-03	37/275	79/275	58/275	58/275	103/275
SED17-29	20/275	36/275	53/275	28/275	145/275
SED17-27	213/275	187/275	205/275	217/275	208/275

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	00-2568-7131	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	08-3704-4652	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control SW	19-4378-7830	25 May-17	25 May-17	40h	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control SW	Control SW	Golder	Control Seawater		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	00-2568-7131	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	17.0%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Control SW		SED17-08	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-06	15.5	15	1	8	0.0550	Asymp	Non-Significant Effect
		SED17-09	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-13	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-17	18.5	15	1	8	0.2006	Asymp	Non-Significant Effect
		SED17-20	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-18	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-19	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-24	24	15	0	8	0.7194	Asymp	Non-Significant Effect
		SED17-12	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-01	25.5	15	1	8	0.8350	Asymp	Non-Significant Effect
		SED17-03	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-29	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-27	15	15	0	8	0.0424	Asymp	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	10.91381	0.7795581	14	59.78	<0.0001	Significant Effect
Error	0.7824633	0.01304105	60			
Total	11.69628		74			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	34.26	29.14	0.0019	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.9493	0.9554	0.0046	Non-normal Distribution

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	5	0.8647	0.8104	0.919	0.8509	0.8364	0.9418	0.01956	5.06%	0.0%
SED17-08	5	0.6545	0.5887	0.7204	0.64	0.6	0.7382	0.02371	8.1%	24.31%
SED17-06	5	0.776	0.7274	0.8246	0.7709	0.7273	0.8364	0.0175	5.04%	10.26%
SED17-09	5	0.07273	0	0.1543	0.04	0.01455	0.1745	0.02938	90.35%	91.59%
SED17-13	5	0.01673	0.007926	0.02553	0.01455	0.007273	0.02545	0.00317	42.38%	98.07%
SED17-17	5	0.7527	0.6272	0.8783	0.7891	0.6182	0.8545	0.04523	13.44%	12.95%
SED17-20	5	0.024	0.01099	0.03701	0.02182	0.01091	0.03636	0.004685	43.65%	97.22%
SED17-18	5	0.3098	0.09369	0.5259	0.2618	0.1273	0.5855	0.07784	56.18%	64.17%
SED17-19	5	0.1411	0.01854	0.2636	0.1273	0.02909	0.2909	0.04414	69.95%	83.68%
SED17-24	5	0.8182	0.6956	0.9408	0.7709	0.72	0.9636	0.04415	12.07%	5.38%
SED17-12	5	0.5665	0.4363	0.6968	0.5345	0.4545	0.7127	0.0469	18.51%	34.48%
SED17-01	5	0.8444	0.8007	0.8881	0.8473	0.7891	0.8873	0.01574	4.17%	2.36%
SED17-03	5	0.2436	0.1307	0.3566	0.2109	0.1345	0.3745	0.04067	37.33%	71.83%
SED17-29	5	0.2051	0	0.4354	0.1309	0.07273	0.5273	0.08296	90.45%	76.28%
SED17-27	5	0.7491	0.6968	0.8014	0.7564	0.68	0.7891	0.01883	5.62%	13.37%

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	00-2568-7131	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	5	1.199	1.109	1.289	1.174	1.154	1.327	0.0324	6.04%	0.0%
SED17-08	5	0.9434	0.873	1.014	0.9273	0.8861	1.034	0.02537	6.01%	21.31%
SED17-06	5	1.079	1.02	1.139	1.072	1.021	1.154	0.02144	4.44%	10.0%
SED17-09	5	0.252	0.0974	0.4066	0.2014	0.1209	0.431	0.05568	49.41%	78.98%
SED17-13	5	0.1271	0.09113	0.1631	0.1209	0.08538	0.1602	0.01297	22.8%	89.4%
SED17-17	5	1.057	0.9114	1.202	1.094	0.9047	1.18	0.05232	11.07%	11.87%
SED17-20	5	0.1524	0.1084	0.1964	0.1483	0.1046	0.1919	0.01584	23.25%	87.29%
SED17-18	5	0.5799	0.3442	0.8156	0.5371	0.3648	0.8713	0.0849	32.74%	51.63%
SED17-19	5	0.3664	0.1829	0.5499	0.3648	0.1714	0.5697	0.06609	40.33%	69.44%
SED17-24	5	1.147	0.9625	1.331	1.072	1.013	1.379	0.06629	12.93%	4.37%
SED17-12	5	0.8537	0.7201	0.9872	0.82	0.7399	1.005	0.04812	12.6%	28.8%
SED17-01	5	1.167	1.107	1.227	1.169	1.094	1.228	0.02147	4.11%	2.66%
SED17-03	5	0.5108	0.3785	0.6431	0.4771	0.3756	0.6586	0.04765	20.86%	57.39%
SED17-29	5	0.447	0.1801	0.714	0.3702	0.2731	0.8127	0.09614	48.09%	62.71%
SED17-27	5	1.047	0.9879	1.106	1.055	0.9695	1.094	0.02133	4.56%	12.66%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	0.8509	0.8545	0.84	0.8364	0.9418
SED17-08	0.64	0.6255	0.6	0.7382	0.6691
SED17-06	0.7782	0.7673	0.8364	0.7709	0.7273
SED17-09	0.04	0.01455	0.03273	0.1018	0.1745
SED17-13	0.02182	0.01455	0.02545	0.01455	0.007273
SED17-17	0.7891	0.8255	0.8545	0.6182	0.6764
SED17-20	0.03273	0.01091	0.01818	0.02182	0.03636
SED17-18	0.2218	0.2618	0.1273	0.3527	0.5855
SED17-19	0.1273	0.1709	0.08727	0.02909	0.2909
SED17-24	0.8727	0.7636	0.9636	0.7709	0.72
SED17-12	0.4982	0.6327	0.7127	0.4545	0.5345
SED17-01	0.8873	0.8509	0.7891	0.8473	0.8473
SED17-03	0.1345	0.2873	0.2109	0.2109	0.3745
SED17-29	0.07273	0.1309	0.1927	0.1018	0.5273
SED17-27	0.7745	0.68	0.7455	0.7891	0.7564

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	1.174	1.18	1.159	1.154	1.327
SED17-08	0.9273	0.9122	0.8861	1.034	0.9579
SED17-06	1.08	1.067	1.154	1.072	1.021
SED17-09	0.2014	0.1209	0.1819	0.3248	0.431
SED17-13	0.1483	0.1209	0.1602	0.1209	0.08538
SED17-17	1.094	1.14	1.18	0.9047	0.9656
SED17-20	0.1819	0.1046	0.1353	0.1483	0.1919
SED17-18	0.4904	0.5371	0.3648	0.6359	0.8713
SED17-19	0.3648	0.4262	0.2999	0.1714	0.5697
SED17-24	1.206	1.063	1.379	1.072	1.013
SED17-12	0.7836	0.9197	1.005	0.7399	0.82
SED17-01	1.228	1.174	1.094	1.169	1.169
SED17-03	0.3756	0.5657	0.4771	0.4771	0.6586
SED17-29	0.2731	0.3702	0.4545	0.3248	0.8127
SED17-27	1.076	0.9695	1.042	1.094	1.055

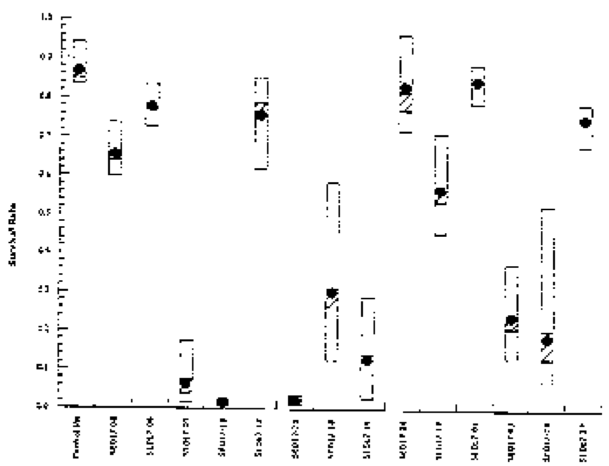
Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

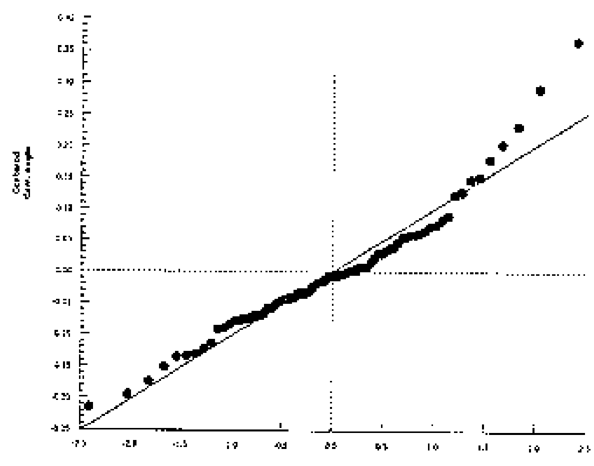
Analysis ID:	00-2568-7131	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	234/275	236/275	231/275	230/275	259/275
SED17-08	176/275	172/275	165/275	203/275	184/275
SED17-06	214/275	211/275	230/275	212/275	200/275
SED17-09	11/275	4/275	9/275	28/275	48/275
SED17-13	6/275	4/275	7/275	4/275	2/275
SED17-17	217/275	227/275	235/275	170/275	186/275
SED17-20	9/275	3/275	5/275	6/275	10/275
SED17-18	61/275	72/275	35/275	97/275	161/275
SED17-19	35/275	47/275	24/275	8/275	80/275
SED17-24	240/275	210/275	265/275	212/275	198/275
SED17-12	137/275	174/275	196/275	125/275	147/275
SED17-01	244/275	234/275	217/275	233/275	233/275
SED17-03	37/275	79/275	58/275	58/275	103/275
SED17-29	20/275	36/275	53/275	28/275	145/275
SED17-27	213/275	187/275	205/275	217/275	208/275

Graphics





CETIS Analytical Report

Report Date:	07 Jun-17 08:42 (p 1 of 4)
Test Code:	170469 | 17-2224-6408

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	20-0939-8303	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	08-3704-4652	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control SW	19-4378-7830	25 May-17	25 May-17	40h	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control SW	Control SW	Golder	Control Seawater		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	20-0939-8303	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	34.5%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Control SW		SED17-08	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-06	16	15	0	8	0.0704	Asymp	Non-Significant Effect
		SED17-09	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-13	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-17	29	15	0	8	0.9712	Asymp	Non-Significant Effect
		SED17-20	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-18	22	15	0	8	0.5241	Asymp	Non-Significant Effect
		SED17-19	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-24	30	15	0	8	0.9848	Asymp	Non-Significant Effect
		SED17-12	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-01	30	15	0	8	0.9848	Asymp	Non-Significant Effect
		SED17-03	22	15	0	8	0.5241	Asymp	Non-Significant Effect
		SED17-29	21	15	0	8	0.4214	Asymp	Non-Significant Effect
		SED17-27	40	15	0	8	1.0000	Asymp	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	12.84225	0.9173039	14	25.16	<0.0001	Significant Effect
Error	2.187184	0.03645306	60			
Total	15.02944		74			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	99.34	29.14	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.877	0.9554	<0.0001	Non-normal Distribution

Proportion Normal Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	5	0.8276	0.8088	0.8465	0.8248	0.8095	0.8511	0.006784	1.83%	0.0%
SED17-08	5	0.007985	0	0.01646	0.005435	0	0.01744	0.003051	85.44%	99.04%
SED17-06	5	0.7952	0.7667	0.8237	0.8	0.76	0.8199	0.01025	2.88%	3.92%
SED17-09	5	0.426	0	0.9121	0.5455	0	0.7857	0.1751	91.91%	48.53%
SED17-13	5	0.03333	0	0.1259	0	0	0.1667	0.03333	223.6%	95.97%
SED17-17	5	0.8371	0.7596	0.9145	0.8495	0.7696	0.9059	0.02789	7.45%	-1.14%
SED17-20	5	0.1333	0	0.5035	0	0	0.6667	0.1333	223.6%	83.89%
SED17-18	5	0.7062	0.4964	0.9159	0.8137	0.459	0.8333	0.07555	23.92%	14.68%
SED17-19	5	0.2579	0	0.6238	0.234	0	0.7125	0.1318	114.3%	68.84%
SED17-24	5	0.8347	0.8013	0.868	0.8292	0.8019	0.8762	0.012	3.21%	-0.85%
SED17-12	5	0.001361	0	0.005138	0	0	0.006803	0.001361	223.6%	99.84%
SED17-01	5	0.834	0.7588	0.9091	0.8484	0.7373	0.8932	0.02706	7.26%	-0.76%
SED17-03	5	0.8056	0.7673	0.8438	0.8155	0.7586	0.8378	0.01378	3.82%	2.67%
SED17-29	5	0.6737	0.465	0.8825	0.6389	0.5	0.8828	0.07519	24.95%	18.6%
SED17-27	5	0.8787	0.8541	0.9032	0.8717	0.8606	0.9122	0.008833	2.25%	-6.17%

Analyst: YWL QA: July 24/17

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	20-0939-8303	Endpoint:	Proportion Normal	CETIS Version:	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	5	1.143	1.118	1.168	1.139	1.119	1.175	0.009073	1.78%	0.0%
SED17-08	5	0.0849	0.03897	0.1308	0.07379	0.0377	0.1325	0.01654	43.57%	92.57%
SED17-06	5	1.102	1.067	1.137	1.107	1.059	1.133	0.01259	2.56%	3.62%
SED17-09	5	0.6796	0.1176	1.242	0.8309	0.1448	1.09	0.2024	66.6%	40.54%
SED17-13	5	0.2955	0.1798	0.4112	0.2527	0.1901	0.4205	0.04168	31.54%	74.15%
SED17-17	5	1.161	1.055	1.267	1.172	1.07	1.259	0.03817	7.35%	-1.55%
SED17-20	5	0.3676	-0.0447	0.7799	0.2255	0.1588	0.9553	0.1485	90.33%	67.84%
SED17-18	5	1.009	0.7805	1.237	1.124	0.7444	1.15	0.08225	18.23%	11.74%
SED17-19	5	0.4831	0.03053	0.9356	0.505	0.1022	1.005	0.163	75.45%	57.74%
SED17-24	5	1.153	1.107	1.199	1.145	1.11	1.211	0.01651	3.2%	-0.88%
SED17-12	5	0.04874	0.02482	0.07265	0.04273	0.03572	0.08257	0.008612	39.52%	95.74%
SED17-01	5	1.155	1.057	1.254	1.171	1.033	1.238	0.03533	6.84%	-1.1%
SED17-03	5	1.115	1.067	1.163	1.127	1.057	1.156	0.01719	3.45%	2.44%
SED17-29	5	0.9751	0.7394	1.211	0.9261	0.7854	1.221	0.08489	19.47%	14.69%
SED17-27	5	1.216	1.177	1.255	1.204	1.188	1.27	0.01412	2.6%	-6.39%

Proportion Normal Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	0.8248	0.8511	0.8095	0.8304	0.8224
SED17-08	0	0.01744	0.01212	0.004926	0.005435
SED17-06	0.8084	0.8199	0.8	0.7877	0.76
SED17-09	0.5455	0	0.7778	0.7857	0.02083
SED17-13	0.1667	0	0	0	0
SED17-17	0.7696	0.7753	0.8851	0.9059	0.8495
SED17-20	0.6667	0	0	0	0
SED17-18	0.459	0.8333	0.6	0.8247	0.8137
SED17-19	0.3429	0.234	0	0	0.7125
SED17-24	0.8292	0.8762	0.8377	0.8019	0.8283
SED17-12	0	0	0	0	0.006803
SED17-01	0.8484	0.8932	0.7373	0.8712	0.8197
SED17-03	0.8378	0.8228	0.7586	0.7931	0.8155
SED17-29	0.5	0.6389	0.8113	0.5357	0.8828
SED17-27	0.8779	0.8717	0.9122	0.871	0.8606

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	1.139	1.175	1.119	1.146	1.136
SED17-08	0.0377	0.1325	0.1103	0.07024	0.07379
SED17-06	1.118	1.133	1.107	1.092	1.059
SED17-09	0.8309	0.2527	1.08	1.09	0.1448
SED17-13	0.4205	0.2527	0.1901	0.2527	0.3614
SED17-17	1.07	1.077	1.225	1.259	1.172
SED17-20	0.9553	0.2928	0.2255	0.2056	0.1588
SED17-18	0.7444	1.15	0.8861	1.139	1.124
SED17-19	0.6255	0.505	0.1022	0.1777	1.005
SED17-24	1.145	1.211	1.156	1.11	1.144
SED17-12	0.04273	0.03791	0.03572	0.04474	0.08257
SED17-01	1.171	1.238	1.033	1.204	1.132
SED17-03	1.156	1.136	1.057	1.099	1.127
SED17-29	0.7854	0.9261	1.121	0.8211	1.221
SED17-27	1.214	1.204	1.27	1.203	1.188

Echinoid Embryo-Larval Survival and Development Test

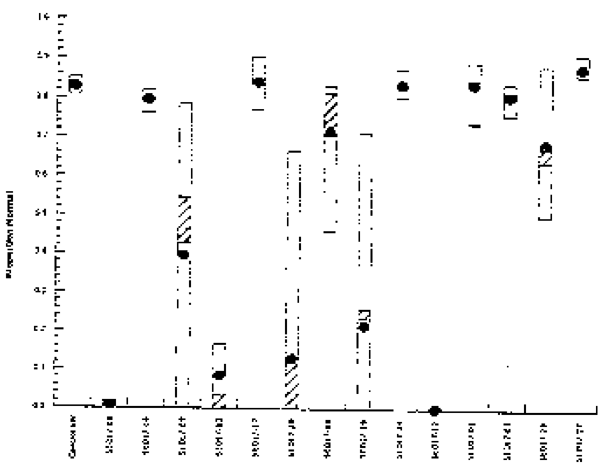
Nautilus Environmental

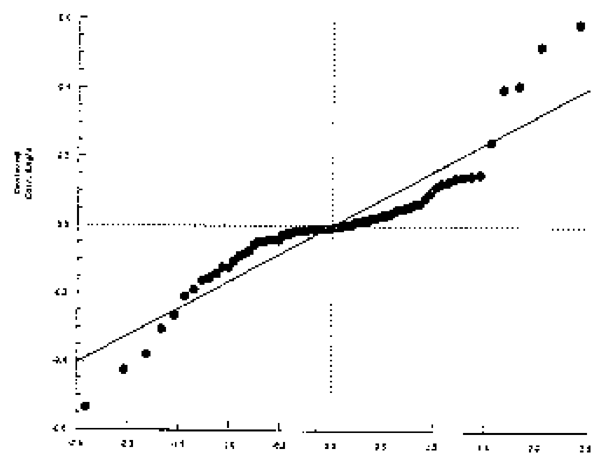
Analysis ID:	20-0939-8303	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Proportion Normal Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	193/234	200/235	187/231	191/230	213/259
SED17-08	0/176	3/172	2/165	1/203	1/184
SED17-06	173/214	173/211	184/230	167/212	152/200
SED17-09	6/11	0/4	7/9	22/28	1/48
SED17-13	1/6	0/4	0/7	0/4	0/2
SED17-17	167/217	176/227	208/235	154/170	158/186
SED17-20	6/9	0/3	0/5	0/6	0/10
SED17-18	28/61	60/72	21/35	80/97	131/161
SED17-19	12/35	11/47	0/24	0/8	57/80
SED17-24	199/240	184/210	222/265	170/212	164/198
SED17-12	0/137	0/174	0/196	0/125	1/147
SED17-01	207/244	209/234	160/217	203/233	191/233
SED17-03	31/37	65/79	44/58	46/58	84/103
SED17-29	10/20	23/36	43/53	15/28	128/145
SED17-27	167/213	163/187	187/205	189/217	179/208

Graphics





CETIS Analytical Report

Report Date:	07 Jun-17 08:42 (p 1 of 4)	Test Code:	170469 | 17-2224-6408

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	20-0809-4194	Endpoint:	Combined Proportion Normal	CETIS Version:	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes
Batch ID:	08-3704-4652	Test Type:	Development-Survival	Analyst:	Yvonne Lam
Start Date:	26 May-17 15:55	Protocol:	PSEP (1995)	Diluent:	Natural seawater
Ending Date:	30 May-17 16:25	Species:	Strongylocentrotus purpuratus	Brine:	
Duration:	4d 1h	Source:	San Diego Lab	Age:	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control SW	19-4378-7630	25 May-17	25 May-17	40h	Golder	
SED17-08	10-1003-8361	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control SW	Control SW	Golder	Control Seawater		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Analyst: YNL DA: July 24/17

Echinoid Embryo-Larval Survival and Development Test

Nautilus Environmental

Analysis ID:	20-0809-4194	Endpoint:	Combined Proportion Normal	CETIS Version:	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	23.6%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Control SW		SED17-08	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-06	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-09	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-13	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-17	19	15	0	8	0.2382	Asymp	Non-Significant Effect
		SED17-20	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-18	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-19	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-24	23	15	0	8	0.6256	Asymp	Non-Significant Effect
		SED17-12	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-01	28.5	15	1	8	0.9613	Asymp	Non-Significant Effect
		SED17-03	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-29	15	15	0	8	0.0424	Asymp	Significant Effect
		SED17-27	17	15	1	8	0.1112	Asymp	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	11.66229	0.8330209	14	72.83	<0.0001	Significant Effect
Error	0.6862382	0.0114373	60			
Total	12.34853		74			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	58.55	29.14	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.898	0.9554	<0.0001	Non-normal Distribution

Combined Proportion Normal Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	5	0.7156	0.6695	0.7617	0.7018	0.68	0.7745	0.0166	5.19%	0.0%
SED17-08	5	0.005091	0	0.01024	0.003636	0	0.01091	0.001854	81.44%	99.29%
SED17-06	5	0.6175	0.5647	0.6702	0.6291	0.5527	0.6691	0.01901	6.89%	13.72%
SED17-09	5	0.02618	0	0.06598	0.02182	0	0.08	0.01433	122.4%	96.34%
SED17-13	5	0.0007273	0	0.002747	0	0	0.003636	0.0007273	223.6%	99.9%
SED17-17	5	0.6276	0.5304	0.7249	0.6073	0.56	0.7564	0.03502	12.48%	12.3%
SED17-20	5	0.004364	0	0.01648	0	0	0.02182	0.004364	223.6%	99.39%
SED17-18	5	0.2327	0.03199	0.4335	0.2182	0.07636	0.4764	0.0723	69.47%	67.48%
SED17-19	5	0.05818	0	0.1649	0.04	0	0.2073	0.03843	147.7%	91.87%
SED17-24	5	0.6829	0.5772	0.7886	0.6691	0.5964	0.8073	0.03808	12.47%	4.57%
SED17-12	5	0.0007273	0	0.002747	0	0	0.003636	0.0007273	223.6%	99.9%
SED17-01	5	0.7055	0.614	0.7969	0.7382	0.5818	0.76	0.03293	10.44%	1.42%
SED17-03	5	0.1964	0.1029	0.2898	0.1673	0.1127	0.3055	0.03366	38.33%	72.56%
SED17-29	5	0.1593	0	0.3793	0.08364	0.03636	0.4655	0.07923	111.2%	77.74%
SED17-27	5	0.6582	0.6096	0.7068	0.68	0.5927	0.6873	0.01752	5.95%	8.03%

Analyst: YW QA: JW 6/24/17

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	20-0809-4194	Endpoint:	Combined Proportion Normal	CETIS Version:	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control SW	5	1.009	0.957	1.061	0.9931	0.9695	1.076	0.01874	4.15%	0.0%
SED17-08	5	0.06817	0.03308	0.1033	0.06034	0.03016	0.1046	0.01264	41.45%	93.24%
SED17-06	5	0.9043	0.8501	0.9585	0.916	0.8382	0.9579	0.01953	4.83%	10.38%
SED17-09	5	0.1371	0.01238	0.2619	0.1483	0.03016	0.2868	0.04494	73.27%	86.41%
SED17-13	5	0.03619	0.01943	0.05295	0.03016	0.03016	0.06034	0.006037	37.3%	96.41%
SED17-17	5	0.9162	0.8125	1.02	0.8935	0.8455	1.055	0.03736	9.12%	9.2%
SED17-20	5	0.05378	-0.0118	0.1194	0.03016	0.03016	0.1483	0.02362	98.21%	94.67%
SED17-18	5	0.4844	0.2428	0.7261	0.486	0.28	0.7618	0.08703	40.17%	51.99%
SED17-19	5	0.189	-0.03622	0.4141	0.2014	0.03016	0.4727	0.0811	95.97%	81.27%
SED17-24	5	0.9757	0.8586	1.093	0.9579	0.8824	1.116	0.04217	9.66%	3.31%
SED17-12	5	0.03619	0.01943	0.05295	0.03016	0.03016	0.06034	0.006037	37.3%	96.41%
SED17-01	5	0.9991	0.9012	1.097	1.034	0.8676	1.059	0.03527	7.89%	0.98%
SED17-03	5	0.4537	0.3367	0.5707	0.4213	0.3424	0.5856	0.04214	20.77%	55.04%
SED17-29	5	0.3757	0.09676	0.6546	0.2934	0.1919	0.7508	0.1005	59.79%	62.77%
SED17-27	5	0.9468	0.896	0.9975	0.9695	0.8787	0.9774	0.01827	4.32%	6.17%

Combined Proportion Normal Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	0.7018	0.7273	0.68	0.6945	0.7745
SED17-08	0	0.01091	0.007273	0.003636	0.003636
SED17-06	0.6291	0.6291	0.6691	0.6073	0.5527
SED17-09	0.02182	0	0.02545	0.08	0.003636
SED17-13	0.003636	0	0	0	0
SED17-17	0.6073	0.64	0.7564	0.56	0.5745
SED17-20	0.02182	0	0	0	0
SED17-18	0.1018	0.2182	0.07636	0.2909	0.4764
SED17-19	0.04364	0.04	0	0	0.2073
SED17-24	0.7236	0.6691	0.8073	0.6182	0.5964
SED17-12	0	0	0	0	0.003636
SED17-01	0.7527	0.76	0.5818	0.7382	0.6945
SED17-03	0.1127	0.2364	0.16	0.1673	0.3055
SED17-29	0.03636	0.08364	0.1564	0.05455	0.4655
SED17-27	0.68	0.5927	0.68	0.6873	0.6509

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	0.9931	1.021	0.9695	0.9852	1.076
SED17-08	0.03016	0.1046	0.08538	0.06034	0.06034
SED17-06	0.916	0.916	0.9579	0.8935	0.8382
SED17-09	0.1483	0.03016	0.1602	0.2868	0.06034
SED17-13	0.06034	0.03016	0.03016	0.03016	0.03016
SED17-17	0.8935	0.9273	1.055	0.8455	0.8602
SED17-20	0.1483	0.03016	0.03016	0.03016	0.03016
SED17-18	0.3248	0.486	0.28	0.5697	0.7618
SED17-19	0.2104	0.2014	0.03016	0.03016	0.4727
SED17-24	1.017	0.9579	1.116	0.9047	0.8824
SED17-12	0.03016	0.03016	0.03016	0.03016	0.06034
SED17-01	1.05	1.059	0.8676	1.034	0.9852
SED17-03	0.3424	0.5077	0.4115	0.4213	0.5856
SED17-29	0.1919	0.2934	0.4065	0.2357	0.7508
SED17-27	0.9695	0.8787	0.9695	0.9774	0.9387

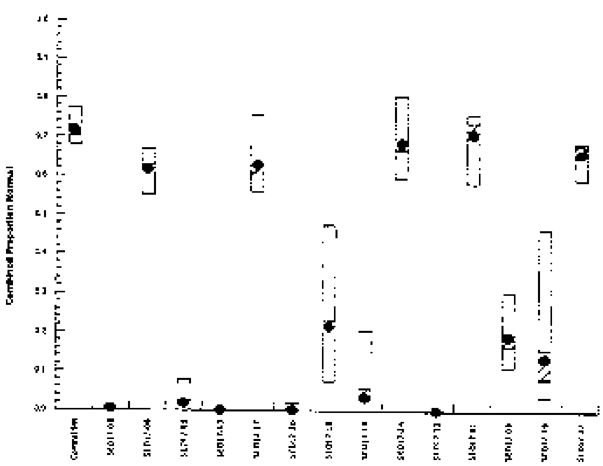
Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

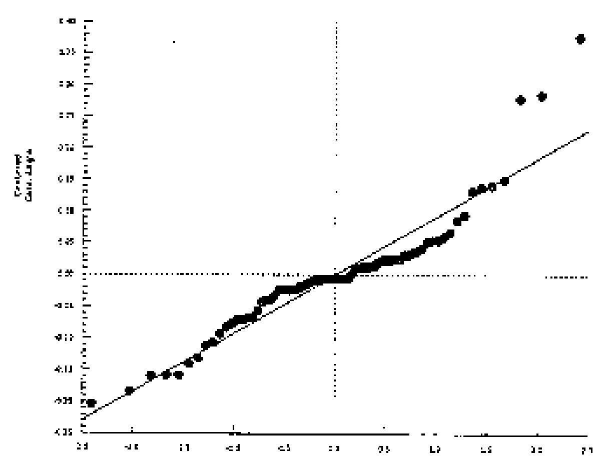
Analysis ID:	20-0809-4194	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jun-17 8:35	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Combined Proportion Normal Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control SW	193/275	200/275	187/275	191/275	213/275
SED17-08	0/275	3/275	2/275	1/275	1/275
SED17-06	173/275	173/275	184/275	167/275	152/275
SED17-09	6/275	0/275	7/275	22/275	1/275
SED17-13	1/275	0/275	0/275	0/275	0/275
SED17-17	167/275	176/275	208/275	154/275	158/275
SED17-20	6/275	0/275	0/275	0/275	0/275
SED17-18	28/275	60/275	21/275	80/275	131/275
SED17-19	12/275	11/275	0/275	0/275	57/275
SED17-24	199/275	184/275	222/275	170/275	164/275
SED17-12	0/275	0/275	0/275	0/275	1/275
SED17-01	207/275	209/275	160/275	203/275	191/275
SED17-03	31/275	65/275	44/275	46/275	64/275
SED17-29	10/275	23/275	43/275	15/275	128/275
SED17-27	187/275	163/275	187/275	189/275	179/275

Graphics





CETIS Analytical Report

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	18-6879-5250	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jul-17 8:10	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	02-2903-0499	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °		
SED17-27	15-6574-8565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	18.5%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
SED17-24		SED17-08	16	15	0	8	0.0670	Asymp	Non-Significant Effect
		SED17-06	26.5	15	1	8	0.8853	Asymp	Non-Significant Effect
		SED17-09	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-13	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-17	24	15	0	8	0.7082	Asymp	Non-Significant Effect
		SED17-20	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-18	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-19	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-12	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-01	31	15	0	8	0.9916	Asymp	Non-Significant Effect
		SED17-03	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-29	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-27	23	15	0	8	0.6133	Asymp	Non-Significant Effect

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	18-6879-5250	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jul-17 8:10	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	9.726428	0.7483406	13	55.03	<0.0001	Significant Effect
Error	0.7614732	0.01359774	56			
Total	10.4899		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	33.05	27.69	0.0017	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.9501	0.9526	0.0073	Non-normal Distribution

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-24	5	0.8182	0.6956	0.9408	0.7709	0.72	0.9636	0.04415	12.07%	0.0%
SED17-08	5	0.6545	0.5887	0.7204	0.64	0.6	0.7382	0.02371	8.1%	20.0%
SED17-06	5	0.776	0.7274	0.8246	0.7709	0.7273	0.8364	0.0175	5.04%	5.16%
SED17-09	5	0.07273	0	0.1543	0.04	0.01455	0.1745	0.02938	90.35%	91.11%
SED17-13	5	0.01673	0.007926	0.02553	0.01455	0.007273	0.02545	0.00317	42.38%	97.96%
SED17-17	5	0.7527	0.6272	0.8783	0.7891	0.6182	0.8545	0.04523	13.44%	8.0%
SED17-20	5	0.024	0.01099	0.03701	0.02182	0.01091	0.03636	0.004685	43.65%	97.07%
SED17-18	5	0.3098	0.09369	0.5259	0.2618	0.1273	0.5855	0.07784	56.18%	62.13%
SED17-19	5	0.1411	0.01854	0.2636	0.1273	0.02909	0.2909	0.04414	69.95%	82.76%
SED17-12	5	0.5665	0.4363	0.6968	0.5345	0.4545	0.7127	0.0469	18.51%	30.76%
SED17-01	5	0.8444	0.8007	0.8881	0.8473	0.7891	0.8873	0.01574	4.17%	-3.2%
SED17-03	5	0.2436	0.1307	0.3566	0.2109	0.1345	0.3745	0.04067	37.33%	70.22%
SED17-29	5	0.2051	0	0.4354	0.1309	0.07273	0.5273	0.08296	90.45%	74.93%
SED17-27	5	0.7491	0.6968	0.8014	0.7564	0.68	0.7891	0.01883	5.62%	8.44%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-24	5	1.147	0.9625	1.331	1.072	1.013	1.379	0.06629	12.93%	0.0%
SED17-08	5	0.9434	0.873	1.014	0.9273	0.8861	1.034	0.02537	6.01%	17.72%
SED17-06	5	1.079	1.02	1.139	1.072	1.021	1.154	0.02144	4.44%	5.89%
SED17-09	5	0.252	0.0974	0.4066	0.2014	0.1209	0.431	0.05568	49.41%	78.02%
SED17-13	5	0.1271	0.09113	0.1631	0.1209	0.08538	0.1602	0.01297	22.8%	88.91%
SED17-17	5	1.057	0.9114	1.202	1.094	0.9047	1.18	0.05232	11.07%	7.84%
SED17-20	5	0.1524	0.1084	0.1964	0.1483	0.1046	0.1919	0.01584	23.25%	86.71%
SED17-18	5	0.5799	0.3442	0.8156	0.5371	0.3648	0.8713	0.0849	32.74%	49.42%
SED17-19	5	0.3664	0.1829	0.5499	0.3648	0.1714	0.5697	0.06609	40.33%	68.04%
SED17-12	5	0.8537	0.7201	0.9872	0.82	0.7399	1.005	0.04812	12.6%	25.55%
SED17-01	5	1.167	1.107	1.227	1.169	1.094	1.228	0.02147	4.11%	-1.78%
SED17-03	5	0.5108	0.3785	0.6431	0.4771	0.3756	0.6586	0.04765	20.86%	55.45%
SED17-29	5	0.447	0.1801	0.714	0.3702	0.2731	0.8127	0.09614	48.09%	61.01%
SED17-27	5	1.047	0.9879	1.106	1.055	0.9695	1.094	0.02133	4.56%	8.67%

Analysis ID:	18-6879-5250	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jul-17 8:10	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	0.8727	0.7636	0.9636	0.7709	0.72
SED17-08	0.64	0.6255	0.6	0.7382	0.6691
SED17-06	0.7782	0.7673	0.8364	0.7709	0.7273
SED17-09	0.04	0.01455	0.03273	0.1018	0.1745
SED17-13	0.02182	0.01455	0.02545	0.01455	0.007273
SED17-17	0.7891	0.8255	0.8545	0.6182	0.6764
SED17-20	0.03273	0.01091	0.01818	0.02182	0.03636
SED17-18	0.2218	0.2618	0.1273	0.3527	0.5855
SED17-19	0.1273	0.1709	0.08727	0.02909	0.2909
SED17-12	0.4982	0.6327	0.7127	0.4545	0.5345
SED17-01	0.8873	0.8509	0.7891	0.8473	0.8473
SED17-03	0.1345	0.2873	0.2109	0.2109	0.3745
SED17-29	0.07273	0.1309	0.1927	0.1018	0.5273
SED17-27	0.7745	0.68	0.7455	0.7891	0.7564

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	1.206	1.063	1.379	1.072	1.013
SED17-08	0.9273	0.9122	0.8861	1.034	0.9579
SED17-06	1.08	1.067	1.154	1.072	1.021
SED17-09	0.2014	0.1209	0.1819	0.3248	0.431
SED17-13	0.1483	0.1209	0.1602	0.1209	0.08538
SED17-17	1.094	1.14	1.18	0.9047	0.9656
SED17-20	0.1819	0.1046	0.1353	0.1483	0.1919
SED17-18	0.4904	0.5371	0.3648	0.6359	0.8713
SED17-19	0.3648	0.4262	0.2999	0.1714	0.5697
SED17-12	0.7836	0.9197	1.005	0.7399	0.82
SED17-01	1.228	1.174	1.094	1.169	1.169
SED17-03	0.3756	0.5657	0.4771	0.4771	0.6586
SED17-29	0.2731	0.3702	0.4545	0.3248	0.8127
SED17-27	1.076	0.9695	1.042	1.094	1.055

Survival Rate Binomials

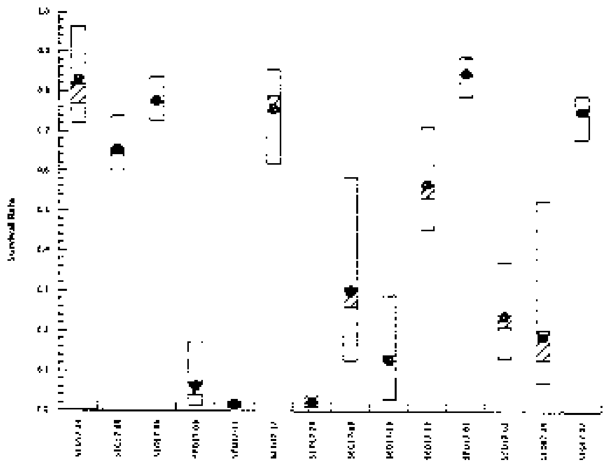
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	240/275	210/275	265/275	212/275	198/275
SED17-08	176/275	172/275	165/275	203/275	184/275
SED17-06	214/275	211/275	230/275	212/275	200/275
SED17-09	11/275	4/275	9/275	28/275	48/275
SED17-13	6/275	4/275	7/275	4/275	2/275
SED17-17	217/275	227/275	235/275	170/275	186/275
SED17-20	9/275	3/275	5/275	6/275	10/275
SED17-18	61/275	72/275	35/275	97/275	161/275
SED17-19	35/275	47/275	24/275	8/275	80/275
SED17-12	137/275	174/275	196/275	125/275	147/275
SED17-01	244/275	234/275	217/275	233/275	233/275
SED17-03	37/275	79/275	58/275	58/275	103/275
SED17-29	20/275	36/275	53/275	28/275	145/275
SED17-27	213/275	187/275	205/275	217/275	208/275

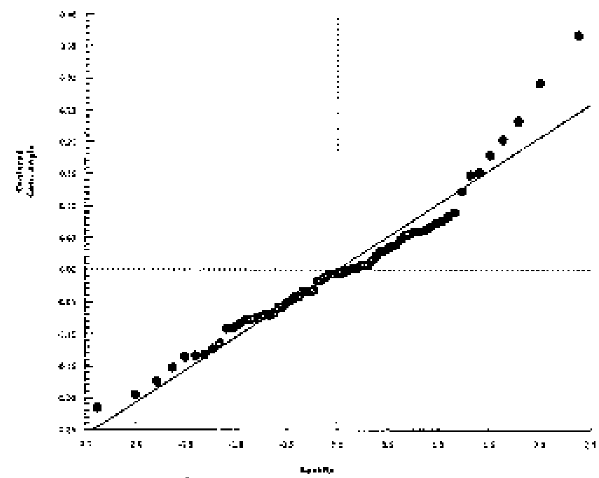
Analyst: VM QA: July 24/17

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	18-6879-5250	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jul-17 8:10	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	04-6069-7708	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jul-17 8:11	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes
Batch ID:	02-2903-0499	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	34.9%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
SED17-24		SED17-08	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-06	17	15	0	8	0.1062	Asymp	Non-Significant Effect
		SED17-09	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-13	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-17	29	15	0	8	0.9687	Asymp	Non-Significant Effect
		SED17-20	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-18	20	15	0	8	0.3138	Asymp	Non-Significant Effect
		SED17-19	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-12	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-01	29	15	0	8	0.9687	Asymp	Non-Significant Effect
		SED17-03	21	15	0	8	0.4096	Asymp	Non-Significant Effect
		SED17-29	21	15	0	8	0.4096	Asymp	Non-Significant Effect
		SED17-27	37	15	0	8	1.0000	Asymp	Non-Significant Effect

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	04-6069-7708	Endpoint:	Proportion Normal	CETIS Version:	CETISv1.8.7
Analyzed:	07 Jul-17 8:11	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	12.2092	0.9391692	13	24.06	<0.0001	Significant Effect
Error	2.185537	0.03902745	56			
Total	14.39474		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	86.35	27.69	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.8924	0.9526	<0.0001	Non-normal Distribution

Proportion Normal Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-24	5	0.8347	0.8013	0.868	0.8292	0.8019	0.8762	0.012	3.21%	0.0%
SED17-08	5	0.007985	0	0.01646	0.005435	0	0.01744	0.003051	85.44%	99.04%
SED17-06	5	0.7952	0.7667	0.8237	0.8	0.76	0.8199	0.01025	2.88%	4.73%
SED17-09	5	0.426	0	0.9121	0.5455	0	0.7857	0.1751	91.91%	48.97%
SED17-13	5	0.03333	0	0.1259	0	0	0.1667	0.03333	223.6%	96.01%
SED17-17	5	0.8371	0.7596	0.9145	0.8495	0.7696	0.9059	0.02789	7.45%	-0.29%
SED17-20	5	0.1333	0	0.5035	0	0	0.6667	0.1333	223.6%	84.03%
SED17-18	5	0.7062	0.4964	0.9159	0.8137	0.459	0.8333	0.07555	23.92%	15.4%
SED17-19	5	0.2579	0	0.6238	0.234	0	0.7125	0.1318	114.3%	69.1%
SED17-12	5	0.001361	0	0.005138	0	0	0.006803	0.001361	223.6%	99.84%
SED17-01	5	0.834	0.7588	0.9091	0.8484	0.7373	0.8932	0.02706	7.26%	0.08%
SED17-03	5	0.8056	0.7673	0.8438	0.8155	0.7586	0.8378	0.01378	3.82%	3.48%
SED17-29	5	0.6737	0.465	0.8825	0.6389	0.5	0.8828	0.07519	24.95%	19.28%
SED17-27	5	0.8787	0.8541	0.9032	0.8717	0.8606	0.9122	0.008833	2.25%	-5.27%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-24	5	1.153	1.107	1.199	1.145	1.11	1.211	0.01651	3.2%	0.0%
SED17-08	5	0.0849	0.03897	0.1308	0.07379	0.0377	0.1325	0.01654	43.57%	92.64%
SED17-06	5	1.102	1.067	1.137	1.107	1.059	1.133	0.01259	2.56%	4.46%
SED17-09	5	0.6796	0.1176	1.242	0.8309	0.1448	1.09	0.2024	66.6%	41.06%
SED17-13	5	0.2955	0.1798	0.4112	0.2527	0.1901	0.4205	0.04168	31.54%	74.37%
SED17-17	5	1.161	1.055	1.267	1.172	1.07	1.259	0.03817	7.35%	-0.66%
SED17-20	5	0.3676	-0.0447	0.7799	0.2255	0.1588	0.9553	0.1485	90.33%	68.12%
SED17-18	5	1.009	0.7805	1.237	1.124	0.7444	1.15	0.08225	18.23%	12.51%
SED17-19	5	0.4831	0.03053	0.9356	0.505	0.1022	1.005	0.163	75.45%	58.1%
SED17-12	5	0.04874	0.02482	0.07265	0.04273	0.03572	0.08257	0.008612	39.52%	95.77%
SED17-01	5	1.155	1.057	1.254	1.171	1.033	1.238	0.03533	6.84%	-0.21%
SED17-03	5	1.115	1.067	1.163	1.127	1.057	1.156	0.01719	3.45%	3.29%
SED17-29	5	0.9751	0.7394	1.211	0.9261	0.7854	1.221	0.08489	19.47%	15.43%
SED17-27	5	1.216	1.177	1.255	1.204	1.188	1.27	0.01412	2.6%	-5.46%

Echinoid Embryo-Larval Survival and Development Test | **Nautilus Environmental**

Analysis ID:	04-6069-7708	**Endpoint:** Proportion Normal		**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jul-17 8:11	**Analysis:** Nonparametric-Control vs Treatments		**Official Results:**	Yes

Proportion Normal Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	0.8292	0.8762	0.8377	0.8019	0.8283
SED17-08	0	0.01744	0.01212	0.004926	0.005435
SED17-06	0.8084	0.8199	0.8	0.7877	0.76
SED17-09	0.5455	0	0.7778	0.7857	0.02083
SED17-13	0.1667	0	0	0	0
SED17-17	0.7696	0.7753	0.8851	0.9059	0.8495
SED17-20	0.6667	0	0	0	0
SED17-18	0.459	0.8333	0.6	0.8247	0.8137
SED17-19	0.3429	0.234	0	0	0.7125
SED17-12	0	0	0	0	0.006803
SED17-01	0.8484	0.8932	0.7373	0.8712	0.8197
SED17-03	0.8378	0.8228	0.7586	0.7931	0.8155
SED17-29	0.5	0.6389	0.8113	0.5357	0.8828
SED17-27	0.8779	0.8717	0.9122	0.871	0.8606

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	1.145	1.211	1.156	1.11	1.144
SED17-08	0.0377	0.1325	0.1103	0.07024	0.07379
SED17-06	1.118	1.133	1.107	1.092	1.059
SED17-09	0.8309	0.2527	1.08	1.09	0.1448
SED17-13	0.4205	0.2527	0.1901	0.2527	0.3614
SED17-17	1.07	1.077	1.225	1.259	1.172
SED17-20	0.9553	0.2928	0.2255	0.2056	0.1588
SED17-18	0.7444	1.15	0.8861	1.139	1.124
SED17-19	0.6255	0.505	0.1022	0.1777	1.005
SED17-12	0.04273	0.03791	0.03572	0.04474	0.08257
SED17-01	1.171	1.238	1.033	1.204	1.132
SED17-03	1.156	1.136	1.057	1.099	1.127
SED17-29	0.7854	0.9261	1.121	0.8211	1.221
SED17-27	1.214	1.204	1.27	1.203	1.188

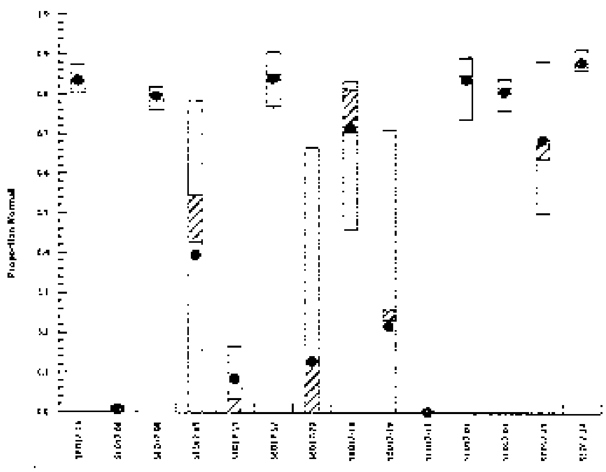
Proportion Normal Binomials

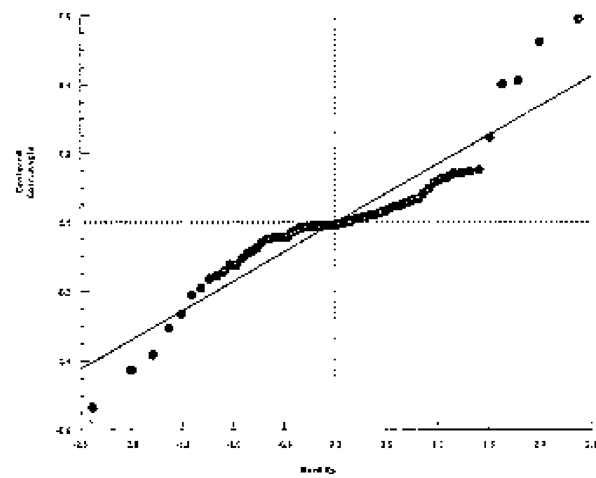
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	199/240	184/210	222/265	170/212	164/198
SED17-08	0/176	3/172	2/165	1/203	1/184
SED17-06	173/214	173/211	184/230	167/212	152/200
SED17-09	6/11	0/4	7/9	22/28	1/48
SED17-13	1/6	0/4	0/7	0/4	0/2
SED17-17	167/217	176/227	208/235	154/170	158/186
SED17-20	6/9	0/3	0/5	0/6	0/10
SED17-18	28/61	60/72	21/35	80/97	131/161
SED17-19	12/35	11/47	0/24	0/8	57/80
SED17-12	0/137	0/174	0/196	0/125	1/147
SED17-01	207/244	209/234	160/217	203/233	191/233
SED17-03	31/37	65/79	44/58	46/58	84/103
SED17-29	10/20	23/36	43/53	15/28	128/145
SED17-27	187/213	163/187	187/205	189/217	179/208

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	04-6069-7708	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jul-17 8:11	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	02-7724-8816	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jul-17 8:11	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	02-2903-0499	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 23h (6.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	25.4%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
SED17-24		SED17-08	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-06	22.5	15	1	8	0.5630	Asymp	Non-Significant Effect
		SED17-09	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-13	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-17	22	15	0	8	0.5116	Asymp	Non-Significant Effect
		SED17-20	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-18	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-19	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-12	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-01	30	15	0	8	0.9833	Asymp	Non-Significant Effect
		SED17-03	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-29	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-27	26	15	0	8	0.8579	Asymp	Non-Significant Effect

Echinoid Embryo-Larval Survival and Development Test | Nautilus Environmental

Analysis ID:	02-7724-8816	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jul-17 8:11	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	10.30497	0.7926897	13	65.36	<0.0001	Significant Effect
Error	0.6792176	0.01212889	56			
Total	10.98418		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	54.66	27.69	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.9013	0.9526	<0.0001	Non-normal Distribution

Combined Proportion Normal Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-24	5	0.6829	0.5772	0.7886	0.6691	0.5964	0.8073	0.03808	12.47%	0.0%
SED17-08	5	0.005091	0	0.01024	0.003636	0	0.01091	0.001854	81.44%	99.25%
SED17-06	5	0.6175	0.5647	0.6702	0.6291	0.5527	0.6691	0.01901	6.89%	9.59%
SED17-09	5	0.02618	0	0.06598	0.02182	0	0.08	0.01433	122.4%	96.17%
SED17-13	5	0.0007273	0	0.002747	0	0	0.003636	0.0007273	223.6%	99.89%
SED17-17	5	0.6276	0.5304	0.7249	0.6073	0.56	0.7564	0.03502	12.48%	8.09%
SED17-20	5	0.004364	0	0.01648	0	0	0.02182	0.004364	223.6%	99.36%
SED17-18	5	0.2327	0.03199	0.4335	0.2182	0.07636	0.4764	0.0723	69.47%	65.92%
SED17-19	5	0.05818	0	0.1649	0.04	0	0.2073	0.03843	147.7%	91.48%
SED17-12	5	0.0007273	0	0.002747	0	0	0.003636	0.0007273	223.6%	99.89%
SED17-01	5	0.7055	0.614	0.7969	0.7382	0.5818	0.76	0.03293	10.44%	-3.3%
SED17-03	5	0.1964	0.1029	0.2898	0.1673	0.1127	0.3055	0.03366	38.33%	71.25%
SED17-29	5	0.1593	0	0.3793	0.08364	0.03636	0.4655	0.07923	111.2%	76.68%
SED17-27	5	0.6582	0.6096	0.7068	0.68	0.5927	0.6873	0.01752	5.95%	3.62%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-24	5	0.9757	0.8586	1.093	0.9579	0.8824	1.116	0.04217	9.66%	0.0%
SED17-08	5	0.06817	0.03308	0.1033	0.06034	0.03016	0.1046	0.01264	41.45%	93.01%
SED17-06	5	0.9043	0.8501	0.9585	0.916	0.8382	0.9579	0.01953	4.83%	7.32%
SED17-09	5	0.1371	0.01238	0.2619	0.1483	0.03016	0.2868	0.04494	73.27%	85.94%
SED17-13	5	0.03619	0.01943	0.05295	0.03016	0.03016	0.06034	0.006037	37.3%	96.29%
SED17-17	5	0.9162	0.8125	1.02	0.8935	0.8455	1.055	0.03736	9.12%	6.1%
SED17-20	5	0.05378	-0.0118	0.1194	0.03016	0.03016	0.1483	0.02362	98.21%	94.49%
SED17-18	5	0.4844	0.2428	0.7261	0.486	0.28	0.7618	0.08703	40.17%	50.35%
SED17-19	5	0.189	-0.03622	0.4141	0.2014	0.03016	0.4727	0.0811	95.97%	80.63%
SED17-12	5	0.03619	0.01943	0.05295	0.03016	0.03016	0.06034	0.006037	37.3%	96.29%
SED17-01	5	0.9991	0.9012	1.097	1.034	0.8676	1.059	0.03527	7.89%	-2.4%
SED17-03	5	0.4537	0.3367	0.5707	0.4213	0.3424	0.5856	0.04214	20.77%	53.5%
SED17-29	5	0.3757	0.09676	0.6546	0.2934	0.1919	0.7508	0.1005	59.79%	61.5%
SED17-27	5	0.9468	0.896	0.9975	0.9695	0.8787	0.9774	0.01827	4.32%	2.97%

Analyst: ___ QA: ___

Analysis ID: 02-7724-8816	Endpoint: Combined Proportion Normal	CETIS Version: CETISv1.8.7
Analyzed: 07 Jul-17 8:11	Analysis: Nonparametric-Control vs Treatments	Official Results: Yes

Combined Proportion Normal Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	0.7236	0.6691	0.8073	0.6182	0.5964
SED17-08	0	0.01091	0.007273	0.003636	0.003636
SED17-06	0.6291	0.6291	0.6691	0.6073	0.5527
SED17-09	0.02182	0	0.02545	0.08	0.003636
SED17-13	0.003636	0	0	0	0
SED17-17	0.6073	0.64	0.7564	0.56	0.5745
SED17-20	0.02182	0	0	0	0
SED17-18	0.1018	0.2182	0.07636	0.2909	0.4764
SED17-19	0.04364	0.04	0	0	0.2073
SED17-12	0	0	0	0	0.003636
SED17-01	0.7527	0.76	0.5818	0.7382	0.6945
SED17-03	0.1127	0.2364	0.16	0.1673	0.3055
SED17-29	0.03636	0.08364	0.1564	0.05455	0.4655
SED17-27	0.68	0.5927	0.68	0.6873	0.6509

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	1.017	0.9579	1.116	0.9047	0.8824
SED17-08	0.03016	0.1046	0.08538	0.06034	0.06034
SED17-06	0.916	0.916	0.9579	0.8935	0.8382
SED17-09	0.1483	0.03016	0.1602	0.2868	0.06034
SED17-13	0.06034	0.03016	0.03016	0.03016	0.03016
SED17-17	0.8935	0.9273	1.055	0.8455	0.8602
SED17-20	0.1483	0.03016	0.03016	0.03016	0.03016
SED17-18	0.3248	0.486	0.28	0.5697	0.7618
SED17-19	0.2104	0.2014	0.03016	0.03016	0.4727
SED17-12	0.03016	0.03016	0.03016	0.03016	0.06034
SED17-01	1.05	1.059	0.8676	1.034	0.9852
SED17-03	0.3424	0.5077	0.4115	0.4213	0.5856
SED17-29	0.1919	0.2934	0.4065	0.2357	0.7508
SED17-27	0.9695	0.8787	0.9695	0.9774	0.9387

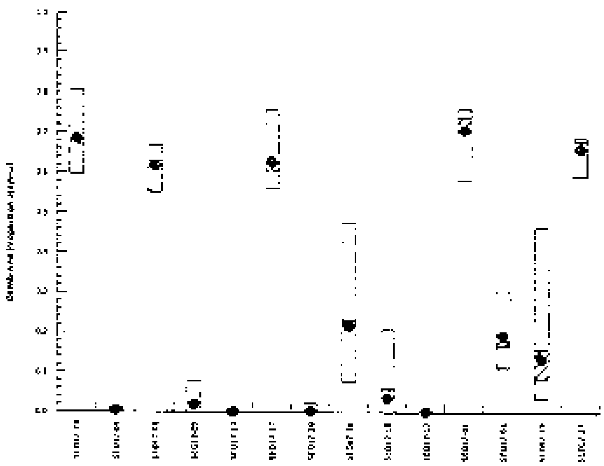
Combined Proportion Normal Binomials

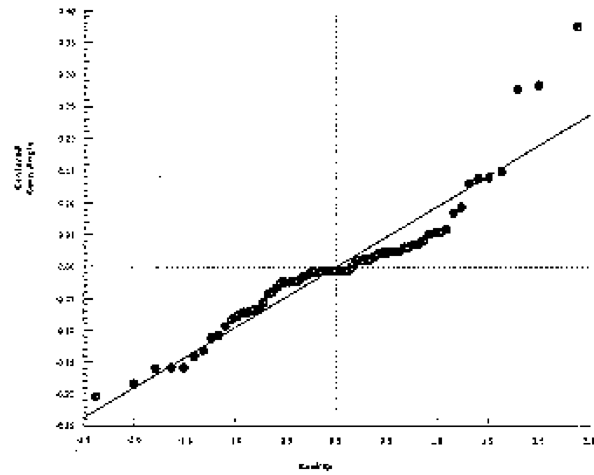
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	199/275	184/275	222/275	170/275	164/275
SED17-08	0/275	3/275	2/275	1/275	1/275
SED17-06	173/275	173/275	184/275	167/275	152/275
SED17-09	6/275	0/275	7/275	22/275	1/275
SED17-13	1/275	0/275	0/275	0/275	0/275
SED17-17	167/275	176/275	208/275	154/275	158/275
SED17-20	6/275	0/275	0/275	0/275	0/275
SED17-18	28/275	60/275	21/275	80/275	131/275
SED17-19	12/275	11/275	0/275	0/275	57/275
SED17-12	0/275	0/275	0/275	0/275	1/275
SED17-01	207/275	209/275	160/275	203/275	191/275
SED17-03	31/275	65/275	44/275	46/275	84/275
SED17-29	10/275	23/275	43/275	15/275	128/275
SED17-27	187/275	163/275	187/275	189/275	179/275

Echinoid Embryo-Larval Survival and Development Test | **Nautilus Environmental**

Analysis ID:	02-7724-8816	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	07 Jul-17 8:11	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





Analyst: YW QA: July 24/17

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	20-6984-3357	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:12	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	13-9688-8689	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	68.8%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
SED17-29		SED17-08	40	15	0	8	1.0000	Asymp	Non-Significant Effect
		SED17-06	40	15	0	8	1.0000	Asymp	Non-Significant Effect
		SED17-09	19.5	15	1	8	0.2699	Asymp	Non-Significant Effect
		SED17-13	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-17	40	15	0	8	1.0000	Asymp	Non-Significant Effect
		SED17-20	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-18	34	15	0	8	0.9993	Asymp	Non-Significant Effect
		SED17-19	25	15	0	8	0.7907	Asymp	Non-Significant Effect
		SED17-24	40	15	0	8	1.0000	Asymp	Non-Significant Effect
		SED17-12	38	15	0	8	1.0000	Asymp	Non-Significant Effect
		SED17-01	40	15	0	8	1.0000	Asymp	Non-Significant Effect
		SED17-03	34	15	0	8	0.9993	Asymp	Non-Significant Effect
		SED17-27	40	15	0	8	1.0000	Asymp	Non-Significant Effect

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	20-6984-3357	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:12	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	9.728428	0.7483406	13	55.03	<0.0001	Significant Effect
Error	0.7614732	0.01359774	56			
Total	10.4899		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	33.05	27.69	0.0017	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.9501	0.9626	0.0073	Non-normal Distribution

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-29	5	0.2051	0	0.4354	0.1309	0.07273	0.5273	0.08296	90.45%	0.0%
SED17-08	5	0.6545	0.5887	0.7204	0.64	0.6	0.7362	0.02371	8.1%	-219.1%
SED17-06	5	0.776	0.7274	0.8246	0.7709	0.7273	0.8364	0.0175	5.04%	-278.4%
SED17-09	5	0.07273	0	0.1543	0.04	0.01455	0.1745	0.02938	90.35%	64.54%
SED17-13	5	0.01673	0.007926	0.02553	0.01455	0.007273	0.02545	0.00317	42.38%	91.84%
SED17-17	5	0.7527	0.6272	0.8783	0.7891	0.6182	0.8545	0.04523	13.44%	-267.0%
SED17-20	5	0.024	0.01099	0.03701	0.02182	0.01091	0.03636	0.004685	43.65%	88.3%
SED17-18	5	0.3098	0.09369	0.5259	0.2618	0.1273	0.5855	0.07784	56.18%	-51.06%
SED17-19	5	0.1411	0.01854	0.2636	0.1273	0.02909	0.2909	0.04414	69.95%	31.21%
SED17-24	5	0.8182	0.6956	0.9408	0.7709	0.72	0.9636	0.04415	12.07%	-298.9%
SED17-12	5	0.5665	0.4363	0.6968	0.5345	0.4545	0.7127	0.0469	18.51%	-176.2%
SED17-01	5	0.8444	0.8007	0.8881	0.8473	0.7891	0.8873	0.01574	4.17%	-311.7%
SED17-03	5	0.2436	0.1307	0.3566	0.2109	0.1345	0.3745	0.04067	37.33%	-18.79%
SED17-27	5	0.7491	0.6968	0.8014	0.7564	0.68	0.7891	0.01883	5.62%	-265.2%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-29	5	0.447	0.1801	0.714	0.3702	0.2731	0.8127	0.09614	48.09%	0.0%
SED17-08	5	0.9434	0.873	1.014	0.9273	0.8861	1.034	0.02537	6.01%	-111.0%
SED17-06	5	1.079	1.02	1.139	1.072	1.021	1.154	0.02144	4.44%	-141.4%
SED17-09	5	0.252	0.0974	0.4066	0.2014	0.1209	0.431	0.05568	49.41%	43.63%
SED17-13	5	0.1271	0.09113	0.1631	0.1209	0.08538	0.1602	0.01297	22.8%	71.56%
SED17-17	5	1.057	0.9114	1.202	1.094	0.9047	1.18	0.05232	11.07%	-136.4%
SED17-20	5	0.1524	0.1084	0.1964	0.1483	0.1046	0.1919	0.01584	23.25%	65.91%
SED17-18	5	0.5799	0.3442	0.8156	0.5371	0.3648	0.8713	0.0849	32.74%	-29.72%
SED17-19	5	0.3664	0.1829	0.5499	0.3648	0.1714	0.5697	0.06609	40.33%	18.04%
SED17-24	5	1.147	0.9625	1.331	1.072	1.013	1.379	0.06629	12.93%	-156.5%
SED17-12	5	0.8537	0.7201	0.9872	0.82	0.7399	1.005	0.04812	12.6%	-90.96%
SED17-01	5	1.167	1.107	1.227	1.169	1.094	1.228	0.02147	4.11%	-161.0%
SED17-03	5	0.5108	0.3785	0.6431	0.4771	0.3756	0.6586	0.04765	20.86%	-14.27%
SED17-27	5	1.047	0.9879	1.106	1.055	0.9695	1.094	0.02133	4.56%	-134.2%

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	20-6984-3357	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	11 Jul-17 9:12	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	0.07273	0.1309	0.1927	0.1018	0.5273
SED17-08	0.64	0.6255	0.6	0.7382	0.6691
SED17-06	0.7782	0.7673	0.8364	0.7709	0.7273
SED17-09	0.04	0.01455	0.03273	0.1018	0.1745
SED17-13	0.02182	0.01455	0.02545	0.01455	0.007273
SED17-17	0.7891	0.8255	0.8545	0.6182	0.6764
SED17-20	0.03273	0.01091	0.01818	0.02182	0.03636
SED17-18	0.2218	0.2618	0.1273	0.3527	0.5855
SED17-19	0.1273	0.1709	0.08727	0.02909	0.2909
SED17-24	0.8727	0.7636	0.9636	0.7709	0.72
SED17-12	0.4982	0.6327	0.7127	0.4545	0.5345
SED17-01	0.8873	0.8509	0.7891	0.8473	0.8473
SED17-03	0.1345	0.2873	0.2109	0.2109	0.3745
SED17-27	0.7745	0.68	0.7455	0.7891	0.7564

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	0.2731	0.3702	0.4545	0.3248	0.8127
SED17-08	0.9273	0.9122	0.8861	1.034	0.9579
SED17-06	1.08	1.067	1.154	1.072	1.021
SED17-09	0.2014	0.1209	0.1819	0.3248	0.431
SED17-13	0.1483	0.1209	0.1602	0.1209	0.08538
SED17-17	1.094	1.14	1.18	0.9047	0.9656
SED17-20	0.1819	0.1046	0.1353	0.1483	0.1919
SED17-18	0.4904	0.5371	0.3648	0.6359	0.8713
SED17-19	0.3648	0.4262	0.2999	0.1714	0.5697
SED17-24	1.206	1.063	1.379	1.072	1.013
SED17-12	0.7836	0.9197	1.005	0.7399	0.82
SED17-01	1.228	1.174	1.094	1.169	1.169
SED17-03	0.3756	0.5657	0.4771	0.4771	0.6586
SED17-27	1.076	0.9695	1.042	1.094	1.055

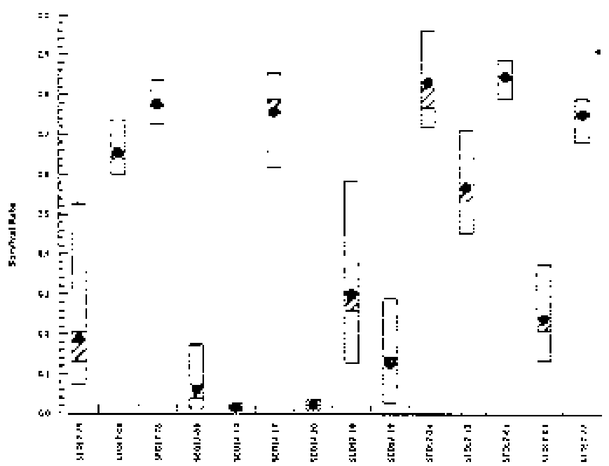
Survival Rate Binomials

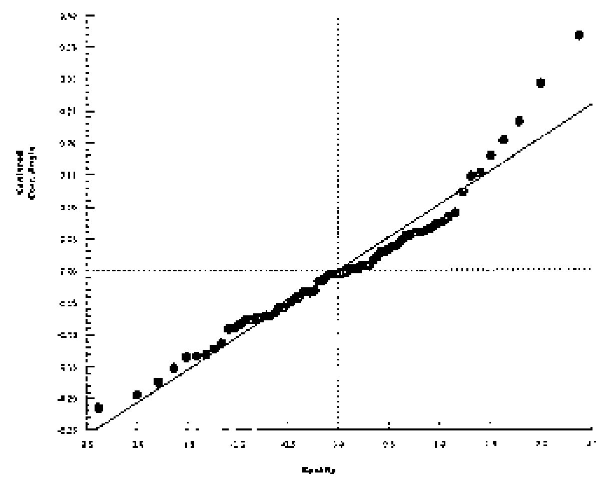
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	20/275	36/275	53/275	28/275	145/275
SED17-08	176/275	172/275	165/275	203/275	184/275
SED17-06	214/275	211/275	230/275	212/275	200/275
SED17-09	11/275	4/275	9/275	28/275	48/275
SED17-13	6/275	4/275	7/275	4/275	2/275
SED17-17	217/275	227/275	235/275	170/275	186/275
SED17-20	9/275	3/275	5/275	6/275	10/275
SED17-18	61/275	72/275	35/275	97/275	161/275
SED17-19	35/275	47/275	24/275	8/275	80/275
SED17-24	240/275	210/275	265/275	212/275	198/275
SED17-12	137/275	174/275	196/275	125/275	147/275
SED17-01	244/275	234/275	217/275	233/275	233/275
SED17-03	37/275	79/275	58/275	58/275	103/275
SED17-27	213/275	187/275	205/275	217/275	208/275

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	20-6984-3357	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:12	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





Analyst: WML QA: July 24/17

CETIS Analytical Report

Report Date: 11 Jul-17 09:12 (p 1 of 4)
Test Code: 170469b | 11-0911-3856

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	08-4455-1105	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:12	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	13-9686-8889	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	45.5%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
SED17-29		SED17-08	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-06	31	15	0	8	0.9916	Asymp	Non-Significant Effect
		SED17-09	23	15	0	8	0.6133	Asymp	Non-Significant Effect
		SED17-13	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-17	35	15	0	8	0.9997	Asymp	Non-Significant Effect
		SED17-20	18	15	0	8	0.1600	Asymp	Non-Significant Effect
		SED17-18	29	15	0	8	0.9687	Asymp	Non-Significant Effect
		SED17-19	18	15	0	8	0.1600	Asymp	Non-Significant Effect
		SED17-24	34	15	0	8	0.9993	Asymp	Non-Significant Effect
		SED17-12	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-01	35	15	0	8	0.9997	Asymp	Non-Significant Effect
		SED17-03	33	15	0	8	0.9983	Asymp	Non-Significant Effect
		SED17-27	36	15	0	8	0.9999	Asymp	Non-Significant Effect

Echinoid Embryo-Larval Survival and Development Test | **Nautilus Environmental**

Analysis ID:	08-4455-1105	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:12	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	12.2092	0.9391692	13	24.06	<0.0001	Significant Effect
Error	2.185537	0.03902745	56			
Total	14.39474		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	86.35	27.69	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.8924	0.9526	<0.0001	Non-normal Distribution

Proportion Normal Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-29	5	0.6737	0.465	0.8825	0.6389	0.5	0.8828	0.07519	24.95%	0.0%
SED17-08	5	0.007985	0	0.01646	0.005435	0	0.01744	0.003051	85.44%	98.81%
SED17-06	5	0.7952	0.7667	0.8237	0.8	0.76	0.8199	0.01025	2.88%	-18.03%
SED17-09	5	0.426	0	0.9121	0.5455	0	0.7857	0.1751	91.91%	36.78%
SED17-13	5	0.03333	0	0.1259	0	0	0.1667	0.03333	223.6%	95.05%
SED17-17	5	0.8371	0.7596	0.9145	0.8495	0.7696	0.9059	0.02789	7.45%	-24.24%
SED17-20	5	0.1333	0	0.5035	0	0	0.6667	0.1333	223.6%	80.21%
SED17-18	5	0.7062	0.4964	0.9159	0.8137	0.459	0.8333	0.07555	23.92%	-4.81%
SED17-19	5	0.2579	0	0.6238	0.234	0	0.7125	0.1318	114.3%	61.72%
SED17-24	5	0.8347	0.8013	0.868	0.8292	0.8019	0.8762	0.012	3.21%	-23.88%
SED17-12	5	0.001361	0	0.005138	0	0	0.006803	0.001361	223.6%	99.8%
SED17-01	5	0.834	0.7588	0.9091	0.8484	0.7373	0.8932	0.02706	7.26%	-23.78%
SED17-03	5	0.8056	0.7673	0.8438	0.8155	0.7586	0.8378	0.01378	3.82%	-19.57%
SED17-27	5	0.8787	0.8541	0.9032	0.8717	0.8606	0.9122	0.008833	2.25%	-30.42%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-29	5	0.9751	0.7394	1.211	0.9261	0.7854	1.221	0.08489	19.47%	0.0%
SED17-08	5	0.0849	0.03897	0.1308	0.07379	0.0377	0.1325	0.01654	43.57%	91.29%
SED17-06	5	1.102	1.067	1.137	1.107	1.059	1.133	0.01259	2.56%	-12.98%
SED17-09	5	0.6796	0.1176	1.242	0.8309	0.1448	1.09	0.2024	66.6%	30.31%
SED17-13	5	0.2955	0.1798	0.4112	0.2527	0.1901	0.4205	0.04168	31.54%	69.7%
SED17-17	5	1.161	1.055	1.267	1.172	1.07	1.259	0.03817	7.35%	-19.03%
SED17-20	5	0.3676	-0.0447	0.7799	0.2255	0.1588	0.9553	0.1485	90.33%	62.3%
SED17-18	5	1.009	0.7805	1.237	1.124	0.7444	1.15	0.08225	18.23%	-3.46%
SED17-19	5	0.4831	0.03053	0.9356	0.505	0.1022	1.005	0.163	75.45%	50.46%
SED17-24	5	1.153	1.107	1.199	1.145	1.11	1.211	0.01651	3.2%	-18.25%
SED17-12	5	0.04874	0.02482	0.07265	0.04273	0.03572	0.08257	0.008612	39.52%	95.0%
SED17-01	5	1.155	1.057	1.254	1.171	1.033	1.238	0.03533	6.84%	-18.5%
SED17-03	5	1.115	1.067	1.163	1.127	1.057	1.156	0.01719	3.45%	-14.35%
SED17-27	5	1.216	1.177	1.255	1.204	1.188	1.27	0.01412	2.6%	-24.7%

Echinoid Embryo-Larval Survival and Development Test — Nautilus Environmental

Analysis ID:	08-4455-1105	Endpoint:	Proportion Normal	CETIS Version:	CETISv1.8.7
Analyzed:	11 Jul-17 9:12	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes

Proportion Normal Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	0.5	0.6389	0.8113	0.5357	0.8828
SED17-08	0	0.01744	0.01212	0.004926	0.005435
SED17-06	0.8084	0.8199	0.8	0.7877	0.76
SED17-09	0.5455	0	0.7778	0.7857	0.02083
SED17-13	0.1667	0	0	0	0
SED17-17	0.7696	0.7753	0.8851	0.9059	0.8495
SED17-20	0.6667	0	0	0	0
SED17-18	0.459	0.8333	0.6	0.8247	0.8137
SED17-19	0.3429	0.234	0	0	0.7125
SED17-24	0.8292	0.8762	0.8377	0.8019	0.8283
SED17-12	0	0	0	0	0.006803
SED17-01	0.8484	0.8932	0.7373	0.8712	0.8197
SED17-03	0.8378	0.8228	0.7586	0.7931	0.8155
SED17-27	0.8779	0.8717	0.9122	0.871	0.8606

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	0.7854	0.9261	1.121	0.8211	1.221
SED17-08	0.0377	0.1325	0.1103	0.07024	0.07379
SED17-06	1.118	1.133	1.107	1.092	1.059
SED17-09	0.8309	0.2527	1.08	1.09	0.1448
SED17-13	0.4205	0.2527	0.1901	0.2527	0.3614
SED17-17	1.07	1.077	1.225	1.259	1.172
SED17-20	0.9553	0.2928	0.2255	0.2056	0.1588
SED17-18	0.7444	1.15	0.8861	1.139	1.124
SED17-19	0.6255	0.505	0.1022	0.1777	1.005
SED17-24	1.145	1.211	1.156	1.11	1.144
SED17-12	0.04273	0.03791	0.03572	0.04474	0.08257
SED17-01	1.171	1.238	1.033	1.204	1.132
SED17-03	1.156	1.136	1.057	1.099	1.127
SED17-27	1.214	1.204	1.27	1.203	1.188

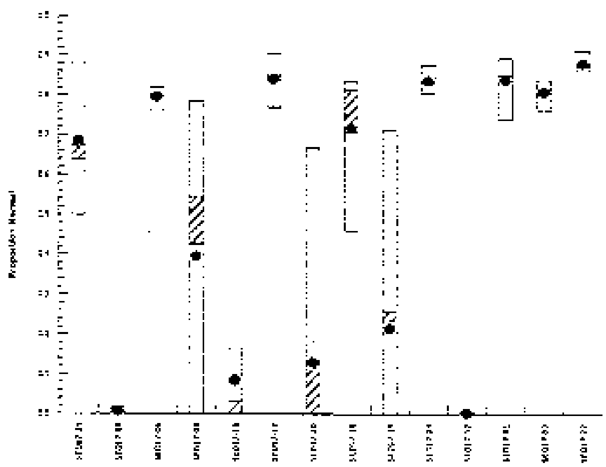
Proportion Normal Binomials

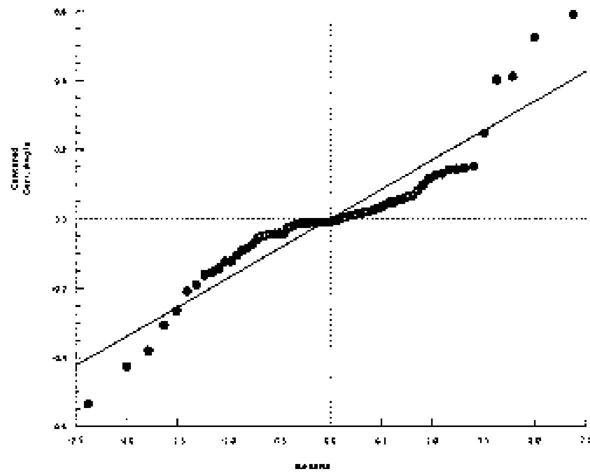
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	10/20	23/36	43/53	15/28	128/145
SED17-08	0/176	3/172	2/165	1/203	1/184
SED17-06	173/214	173/211	184/230	167/212	152/200
SED17-09	6/11	0/4	7/9	22/28	1/48
SED17-13	1/6	0/4	0/7	0/4	0/2
SED17-17	167/217	176/227	208/235	154/170	158/186
SED17-20	6/9	0/3	0/5	0/6	0/10
SED17-18	28/61	60/72	21/35	80/97	131/161
SED17-19	12/35	11/47	0/24	0/8	57/80
SED17-24	199/240	184/210	222/265	170/212	164/198
SED17-12	0/137	0/174	0/196	0/125	1/147
SED17-01	207/244	209/234	160/217	203/233	191/233
SED17-03	31/37	65/79	44/58	46/58	84/103
SED17-27	187/213	163/187	187/205	189/217	179/208

Analyst: YWL QA: July 24/17

Analysis ID:	08-4455-1105	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:12	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	11-7006-2971	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:12	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	13-9688-8889	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	76.4%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
SED17-29		SED17-08	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-06	40	15	0	8	1.0000	Asymp	Non-Significant Effect
		SED17-09	17	15	0	8	0.1062	Asymp	Non-Significant Effect
		SED17-13	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-17	40	15	0	8	1.0000	Asymp	Non-Significant Effect
		SED17-20	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-18	33	15	0	8	0.9983	Asymp	Non-Significant Effect
		SED17-19	21	15	0	8	0.4096	Asymp	Non-Significant Effect
		SED17-24	40	15	0	8	1.0000	Asymp	Non-Significant Effect
		SED17-12	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-01	40	15	0	8	1.0000	Asymp	Non-Significant Effect
		SED17-03	34	15	0	8	0.9993	Asymp	Non-Significant Effect
		SED17-27	40	15	0	8	1.0000	Asymp	Non-Significant Effect

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	11-7006-2971	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:12	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	10.30497	0.7926897	13	65.36	<0.0001	Significant Effect
Error	0.6792176	0.01212889	56			
Total	10.98418		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	54.66	27.69	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.9013	0.9526	<0.0001	Non-normal Distribution

Combined Proportion Normal Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-29	5	0.1593	0	0.3793	0.08364	0.03636	0.4655	0.07923	111.2%	0.0%
SED17-08	5	0.005091	0	0.01024	0.003636	0	0.01091	0.001854	81.44%	96.8%
SED17-06	5	0.6175	0.5647	0.6702	0.6291	0.5527	0.6691	0.01901	6.89%	-287.7%
SED17-09	5	0.02618	0	0.06598	0.02182	0	0.08	0.01433	122.4%	83.56%
SED17-13	5	0.0007273	0	0.002747	0	0	0.003636	0.0007273	223.6%	99.54%
SED17-17	5	0.6276	0.5304	0.7249	0.6073	0.56	0.7564	0.03502	12.48%	-294.1%
SED17-20	5	0.004364	0	0.01648	0	0	0.02182	0.004364	223.6%	97.26%
SED17-18	5	0.2327	0.03199	0.4335	0.2182	0.07636	0.4764	0.0723	69.47%	-46.12%
SED17-19	5	0.05818	0	0.1649	0.04	0	0.2073	0.03843	147.7%	63.47%
SED17-24	5	0.6829	0.5772	0.7886	0.6691	0.5964	0.8073	0.03808	12.47%	-328.8%
SED17-12	5	0.0007273	0	0.002747	0	0	0.003636	0.0007273	223.6%	99.54%
SED17-01	5	0.7055	0.614	0.7969	0.7382	0.5818	0.76	0.03293	10.44%	-342.9%
SED17-03	5	0.1964	0.1029	0.2898	0.1673	0.1127	0.3055	0.03366	38.33%	-23.29%
SED17-27	5	0.6582	0.6096	0.7068	0.68	0.5927	0.6873	0.01752	5.95%	-313.2%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-29	5	0.3757	0.09676	0.6546	0.2934	0.1919	0.7508	0.1005	59.79%	0.0%
SED17-08	5	0.06817	0.03308	0.1033	0.06034	0.03016	0.1046	0.01264	41.45%	81.85%
SED17-06	5	0.9043	0.8501	0.9585	0.916	0.8382	0.9579	0.01953	4.83%	-140.7%
SED17-09	5	0.1371	0.01238	0.2619	0.1483	0.03016	0.2868	0.04494	73.27%	63.49%
SED17-13	5	0.03619	0.01943	0.05295	0.03016	0.03016	0.06034	0.006037	37.3%	90.37%
SED17-17	5	0.9162	0.8125	1.02	0.8935	0.8455	1.055	0.03736	9.12%	-143.9%
SED17-20	5	0.05378	-0.0118	0.1194	0.03016	0.03016	0.1483	0.02362	98.21%	85.69%
SED17-18	5	0.4844	0.2428	0.7261	0.486	0.28	0.7618	0.08703	40.17%	-28.95%
SED17-19	5	0.189	-0.03622	0.4141	0.2014	0.03016	0.4727	0.0811	95.97%	49.7%
SED17-24	5	0.9757	0.8586	1.093	0.9579	0.8824	1.116	0.04217	9.66%	-159.7%
SED17-12	5	0.03619	0.01943	0.05295	0.03016	0.03016	0.06034	0.006037	37.3%	90.37%
SED17-01	5	0.9991	0.9012	1.097	1.034	0.8676	1.059	0.03527	7.89%	-166.0%
SED17-03	5	0.4537	0.3367	0.5707	0.4213	0.3424	0.5856	0.04214	20.77%	-20.77%
SED17-27	5	0.9468	0.896	0.9976	0.9695	0.8787	0.9774	0.01827	4.32%	-152.0%

Analysis ID:	11-7006-2971	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:12	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Combined Proportion Normal Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	0.03636	0.08364	0.1564	0.05455	0.4655
SED17-08	0	0.01091	0.007273	0.003636	0.003636
SED17-06	0.6291	0.6291	0.6691	0.6073	0.5527
SED17-09	0.02182	0	0.02545	0.08	0.003636
SED17-13	0.003636	0	0	0	0
SED17-17	0.6073	0.64	0.7564	0.56	0.5745
SED17-20	0.02182	0	0	0	0
SED17-18	0.1018	0.2182	0.07636	0.2909	0.4764
SED17-19	0.04364	0.04	0	0	0.2073
SED17-24	0.7236	0.6691	0.8073	0.6182	0.5964
SED17-12	0	0	0	0	0.003636
SED17-01	0.7527	0.76	0.5818	0.7382	0.6945
SED17-03	0.1127	0.2364	0.16	0.1673	0.3055
SED17-27	0.68	0.5927	0.68	0.6873	0.6509

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	0.1919	0.2934	0.4065	0.2357	0.7508
SED17-08	0.03016	0.1046	0.08538	0.06034	0.06034
SED17-06	0.916	0.916	0.9579	0.8935	0.8382
SED17-09	0.1483	0.03016	0.1602	0.2868	0.06034
SED17-13	0.06034	0.03016	0.03016	0.03016	0.03016
SED17-17	0.8935	0.9273	1.055	0.8455	0.8602
SED17-20	0.1483	0.03016	0.03016	0.03016	0.03016
SED17-18	0.3248	0.486	0.28	0.5697	0.7618
SED17-19	0.2104	0.2014	0.03016	0.03016	0.4727
SED17-24	1.017	0.9579	1.116	0.9047	0.8824
SED17-12	0.03016	0.03016	0.03016	0.03016	0.06034
SED17-01	1.05	1.059	0.8676	1.034	0.9852
SED17-03	0.3424	0.5077	0.4115	0.4213	0.5856
SED17-27	0.9695	0.8787	0.9695	0.9774	0.9387

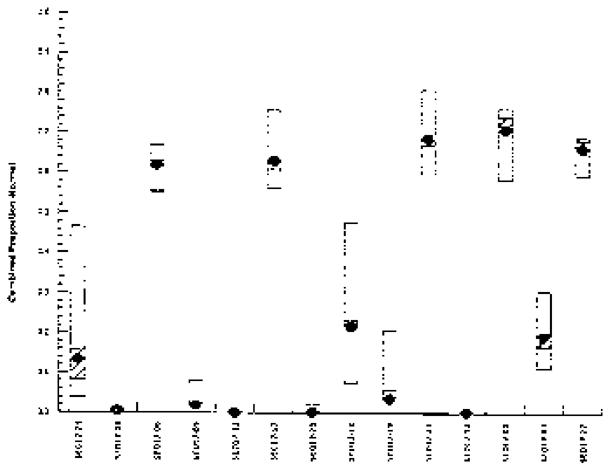
Combined Proportion Normal Binomials

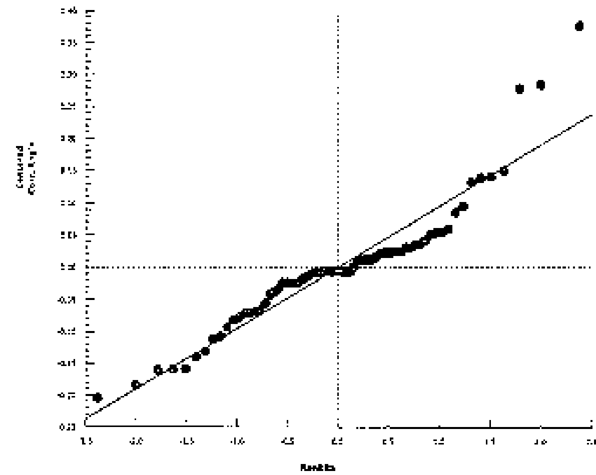
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	10/275	23/275	43/275	15/275	128/275
SED17-08	0/275	3/275	2/275	1/275	1/275
SED17-06	173/275	173/275	184/275	167/275	152/275
SED17-09	6/275	0/275	7/275	22/275	1/275
SED17-13	1/275	0/275	0/275	0/275	0/275
SED17-17	167/275	176/275	208/275	154/275	158/275
SED17-20	6/275	0/275	0/275	0/275	0/275
SED17-18	28/275	60/275	21/275	80/275	131/275
SED17-19	12/275	11/275	0/275	0/275	57/275
SED17-24	199/275	184/275	222/275	170/275	164/275
SED17-12	0/275	0/275	0/275	0/275	1/275
SED17-01	207/275	209/275	160/275	203/275	191/275
SED17-03	31/275	65/275	44/275	46/275	84/275
SED17-27	187/275	163/275	187/275	189/275	179/275

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID: 11-7006-2971		**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed: 11 Jul-17 9:12		**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





Echinoid Embryo-Larval Development Test **Nautilus Environmental**

Analysis ID:	02-3422-1085	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:21	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	12-0901-2008	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-27	Sediment Sample	Golder	SED17-27		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	23.9%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
SED17-27		SED17-08	16	15	0	8	0.0670	Asymp	Non-Significant Effect
		SED17-06	31	15	0	8	0.9916	Asymp	Non-Significant Effect
		SED17-09	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-13	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-17	29.5	15	1	8	0.9769	Asymp	Non-Significant Effect
		SED17-20	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-18	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-19	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-24	32	15	0	8	0.9961	Asymp	Non-Significant Effect
		SED17-12	16	15	0	8	0.0670	Asymp	Non-Significant Effect
		SED17-01	39.5	15	1	8	1.0000	Asymp	Non-Significant Effect
		SED17-03	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-29	15	15	0	8	0.0402	Asymp	Significant Effect

Analysis ID:	02-3422-1085	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:21	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	9.728428	0.7483406	13	55.03	<0.0001	Significant Effect
Error	0.7614732	0.01359774	56			
Total	10.4899		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	33.05	27.69	0.0017	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.9501	0.9526	0.0073	Non-normal Distribution

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-27	5	0.7491	0.6968	0.8014	0.7564	0.68	0.7891	0.01883	5.62%	0.0%
SED17-08	5	0.6545	0.5887	0.7204	0.64	0.6	0.7382	0.02371	8.1%	12.62%
SED17-06	5	0.776	0.7274	0.8246	0.7709	0.7273	0.8364	0.0175	5.04%	-3.59%
SED17-09	5	0.07273	0	0.1543	0.04	0.01455	0.1745	0.02938	90.35%	90.29%
SED17-13	5	0.01673	0.007926	0.02553	0.01455	0.007273	0.02545	0.00317	42.38%	97.77%
SED17-17	5	0.7527	0.6272	0.8783	0.7891	0.6182	0.8545	0.04523	13.44%	-0.49%
SED17-20	5	0.024	0.01099	0.03701	0.02182	0.01091	0.03636	0.004685	43.65%	96.8%
SED17-18	5	0.3098	0.09369	0.5259	0.2618	0.1273	0.5855	0.07784	56.18%	58.64%
SED17-19	5	0.1411	0.01854	0.2636	0.1273	0.02909	0.2909	0.04414	69.95%	81.17%
SED17-24	5	0.8182	0.6956	0.9408	0.7709	0.72	0.9636	0.04415	12.07%	-9.22%
SED17-12	5	0.5665	0.4363	0.6968	0.5345	0.4545	0.7127	0.0469	18.51%	24.37%
SED17-01	5	0.8444	0.8007	0.8881	0.8473	0.7891	0.8873	0.01574	4.17%	-12.72%
SED17-03	5	0.2435	0.1307	0.3566	0.2109	0.1345	0.3745	0.04067	37.33%	67.48%
SED17-29	5	0.2051	0	0.4354	0.1309	0.07273	0.5273	0.08296	90.45%	72.62%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-27	5	1.047	0.9879	1.106	1.055	0.9695	1.094	0.02133	4.56%	0.0%
SED17-08	5	0.9434	0.873	1.014	0.9273	0.8861	1.034	0.02537	6.01%	9.91%
SED17-06	5	1.079	1.02	1.139	1.072	1.021	1.154	0.02144	4.44%	-3.04%
SED17-09	5	0.252	0.0974	0.4066	0.2014	0.1209	0.431	0.05568	49.41%	75.94%
SED17-13	5	0.1271	0.09113	0.1631	0.1209	0.08538	0.1602	0.01297	22.8%	87.86%
SED17-17	5	1.057	0.9114	1.202	1.094	0.9047	1.18	0.05232	11.07%	-0.91%
SED17-20	5	0.1524	0.1084	0.1964	0.1483	0.1046	0.1919	0.01584	23.25%	85.45%
SED17-18	5	0.5799	0.3442	0.8156	0.5371	0.3648	0.8713	0.0849	32.74%	44.62%
SED17-19	5	0.3664	0.1829	0.5499	0.3648	0.1714	0.5697	0.06609	40.33%	65.01%
SED17-24	5	1.147	0.9625	1.331	1.072	1.013	1.379	0.06629	12.93%	-9.5%
SED17-12	5	0.8537	0.7201	0.9872	0.82	0.7399	1.005	0.04812	12.6%	18.48%
SED17-01	5	1.167	1.107	1.227	1.169	1.094	1.228	0.02147	4.11%	-11.45%
SED17-03	5	0.5108	0.3785	0.6431	0.4771	0.3756	0.6586	0.04765	20.86%	51.22%
SED17-29	5	0.447	0.1801	0.714	0.3702	0.2731	0.8127	0.09614	48.09%	57.31%

Analyst: ynı QA: July 24/17

Analysis ID:	02-3422-1085	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	11 Jul-17 9:21	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	0.7745	0.68	0.7455	0.7891	0.7564
SED17-08	0.64	0.6255	0.6	0.7382	0.6691
SED17-06	0.7782	0.7673	0.8364	0.7709	0.7273
SED17-09	0.04	0.01455	0.03273	0.1018	0.1745
SED17-13	0.02182	0.01455	0.02545	0.01455	0.007273
SED17-17	0.7891	0.8255	0.8545	0.6182	0.6764
SED17-20	0.03273	0.01091	0.01818	0.02182	0.03636
SED17-18	0.2218	0.2618	0.1273	0.3527	0.5855
SED17-19	0.1273	0.1709	0.08727	0.02909	0.2909
SED17-24	0.8727	0.7636	0.9636	0.7709	0.72
SED17-12	0.4982	0.6327	0.7127	0.4545	0.5345
SED17-01	0.8873	0.8509	0.7891	0.8473	0.8473
SED17-03	0.1345	0.2873	0.2109	0.2109	0.3745
SED17-29	0.07273	0.1309	0.1927	0.1018	0.5273

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	1.076	0.9695	1.042	1.094	1.055
SED17-08	0.9273	0.9122	0.8861	1.034	0.9579
SED17-06	1.08	1.067	1.154	1.072	1.021
SED17-09	0.2014	0.1209	0.1819	0.3248	0.431
SED17-13	0.1483	0.1209	0.1602	0.1209	0.08538
SED17-17	1.094	1.14	1.18	0.9047	0.9656
SED17-20	0.1819	0.1046	0.1353	0.1483	0.1919
SED17-18	0.4904	0.5371	0.3648	0.6359	0.8713
SED17-19	0.3648	0.4262	0.2999	0.1714	0.5697
SED17-24	1.206	1.063	1.379	1.072	1.013
SED17-12	0.7836	0.9197	1.005	0.7399	0.82
SED17-01	1.228	1.174	1.094	1.169	1.169
SED17-03	0.3756	0.5657	0.4771	0.4771	0.6586
SED17-29	0.2731	0.3702	0.4545	0.3248	0.8127

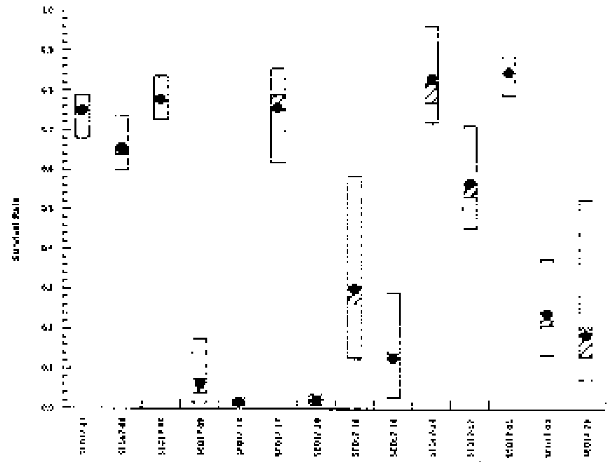
Survival Rate Binomials

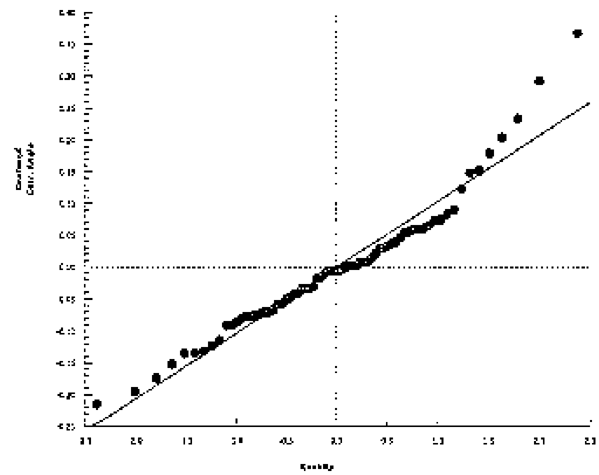
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	213/275	187/275	205/275	217/275	208/275
SED17-08	176/275	172/275	165/275	203/275	184/275
SED17-06	214/275	211/275	230/275	212/275	200/275
SED17-09	11/275	4/275	9/275	28/275	48/275
SED17-13	6/275	4/275	7/275	4/275	2/275
SED17-17	217/275	227/275	235/275	170/275	186/275
SED17-20	9/275	3/275	5/275	6/275	10/275
SED17-18	61/275	72/275	35/275	97/275	161/275
SED17-19	35/275	47/275	24/275	8/275	80/275
SED17-24	240/275	210/275	265/275	212/275	198/275
SED17-12	137/275	174/275	196/275	125/275	147/275
SED17-01	244/275	234/275	217/275	233/275	233/275
SED17-03	37/275	79/275	58/275	58/275	103/275
SED17-29	20/275	36/275	53/275	28/275	145/275

Echinoid Embryo-Larval Development Test | **Nautilus Environmental**

Analysis ID:	02-3422-1085	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:21	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





Echinoid Embryo-Larval Development Test — Nautilus Environmental

Analysis ID:	14-4425-7852	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:21	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	12-0901-2008	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-27	15-8574-6565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-27	Sediment Sample	Golder	SED17-27		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	31.1%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
SED17-27		SED17-08	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-06	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-09	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-13	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-17	23	15	0	8	0.6133	Asymp	Non-Significant Effect
		SED17-20	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-18	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-19	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-24	18	15	0	8	0.1600	Asymp	Non-Significant Effect
		SED17-12	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-01	21	15	0	8	0.4096	Asymp	Non-Significant Effect
		SED17-03	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-29	19	15	0	8	0.2295	Asymp	Non-Significant Effect

Echinoid Embryo-Larval Development Test — Nautilus Environmental

Analysis ID:	14-4425-7852	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:21	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	12.2092	0.9391692	13	24.06	<0.0001	Significant Effect
Error	2.185537	0.03902745	56			
Total	14.39474		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	86.35	27.69	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.8924	0.9526	<0.0001	Non-normal Distribution

Proportion Normal Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-27	5	0.8787	0.8541	0.9032	0.8717	0.8606	0.9122	0.008833	2.25%	0.0%
SED17-08	5	0.007985	0	0.01646	0.005435	0	0.01744	0.003051	85.44%	99.09%
SED17-06	5	0.7952	0.7667	0.8237	0.8	0.76	0.8199	0.01025	2.88%	9.5%
SED17-09	5	0.426	0	0.9121	0.5455	0	0.7857	0.1751	91.91%	51.52%
SED17-13	5	0.03333	0	0.1259	0	0	0.1667	0.03333	223.6%	96.21%
SED17-17	5	0.8371	0.7596	0.9145	0.8495	0.7696	0.9059	0.02789	7.45%	4.73%
SED17-20	5	0.1333	0	0.5035	0	0	0.6667	0.1333	223.6%	84.83%
SED17-18	5	0.7062	0.4964	0.9159	0.8137	0.459	0.8333	0.07555	23.92%	19.63%
SED17-19	5	0.2579	0	0.6236	0.234	0	0.7125	0.1318	114.3%	70.65%
SED17-24	5	0.8347	0.8013	0.868	0.8292	0.8019	0.8762	0.012	3.21%	5.01%
SED17-12	5	0.001361	0	0.005138	0	0	0.006803	0.001361	223.6%	99.85%
SED17-01	5	0.834	0.7588	0.9091	0.8484	0.7373	0.8932	0.02706	7.26%	5.09%
SED17-03	5	0.8056	0.7673	0.8438	0.8155	0.7586	0.8378	0.01378	3.82%	8.32%
SED17-29	5	0.6737	0.465	0.8825	0.6389	0.5	0.8828	0.07519	24.95%	23.32%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-27	5	1.216	1.177	1.255	1.204	1.188	1.27	0.01412	2.6%	0.0%
SED17-08	5	0.0849	0.03897	0.1308	0.07379	0.0377	0.1325	0.01654	43.57%	93.02%
SED17-06	5	1.102	1.067	1.137	1.107	1.059	1.133	0.01259	2.56%	9.4%
SED17-09	5	0.6796	0.1176	1.242	0.8309	0.1448	1.09	0.2024	66.6%	44.11%
SED17-13	5	0.2955	0.1798	0.4112	0.2527	0.1901	0.4205	0.04168	31.54%	75.7%
SED17-17	5	1.161	1.055	1.267	1.172	1.07	1.259	0.03817	7.35%	4.55%
SED17-20	5	0.3676	-0.0447	0.7799	0.2255	0.1588	0.9553	0.1485	90.33%	69.77%
SED17-18	5	1.009	0.7805	1.237	1.124	0.7444	1.15	0.08225	18.23%	17.04%
SED17-19	5	0.4831	0.03053	0.9356	0.505	0.1022	1.005	0.163	75.45%	60.27%
SED17-24	5	1.153	1.107	1.199	1.145	1.11	1.211	0.01651	3.2%	5.17%
SED17-12	5	0.04874	0.02482	0.07265	0.04273	0.03572	0.08257	0.008612	39.52%	95.99%
SED17-01	5	1.155	1.057	1.254	1.171	1.033	1.238	0.03533	6.84%	4.97%
SED17-03	5	1.115	1.067	1.163	1.127	1.057	1.156	0.01719	3.45%	8.3%
SED17-29	5	0.9751	0.7394	1.211	0.9261	0.7854	1.221	0.08489	19.47%	19.81%

Analyst: [illegible] QA: July 24/17

Analysis ID:	14-4425-7852	Endpoint:	Proportion Normal	CETIS Version:	CETISv1.8.7
Analyzed:	11 Jul-17 9:21	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes

Proportion Normal Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	0.8779	0.8717	0.9122	0.871	0.8606
SED17-08	0	0.01744	0.01212	0.004926	0.005435
SED17-06	0.8084	0.8199	0.8	0.7877	0.76
SED17-09	0.5455	0	0.7778	0.7857	0.02083
SED17-13	0.1667	0	0	0	0
SED17-17	0.7696	0.7753	0.8851	0.9059	0.8495
SED17-20	0.6667	0	0	0	0
SED17-18	0.459	0.8333	0.6	0.8247	0.8137
SED17-19	0.3429	0.234	0	0	0.7125
SED17-24	0.8292	0.8762	0.8377	0.8019	0.8283
SED17-12	0	0	0	0	0.006803
SED17-01	0.8484	0.8932	0.7373	0.8712	0.8197
SED17-03	0.8378	0.8228	0.7586	0.7931	0.8155
SED17-29	0.5	0.6389	0.8113	0.5357	0.8828

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	1.214	1.204	1.27	1.203	1.188
SED17-08	0.0377	0.1325	0.1103	0.07024	0.07379
SED17-06	1.118	1.133	1.107	1.092	1.059
SED17-09	0.8309	0.2527	1.08	1.09	0.1448
SED17-13	0.4205	0.2527	0.1901	0.2527	0.3614
SED17-17	1.07	1.077	1.225	1.259	1.172
SED17-20	0.9553	0.2928	0.2255	0.2056	0.1588
SED17-18	0.7444	1.15	0.8861	1.139	1.124
SED17-19	0.6255	0.505	0.1022	0.1777	1.005
SED17-24	1.145	1.211	1.156	1.11	1.144
SED17-12	0.04273	0.03791	0.03572	0.04474	0.08257
SED17-01	1.171	1.238	1.033	1.204	1.132
SED17-03	1.156	1.136	1.057	1.099	1.127
SED17-29	0.7854	0.9261	1.121	0.8211	1.221

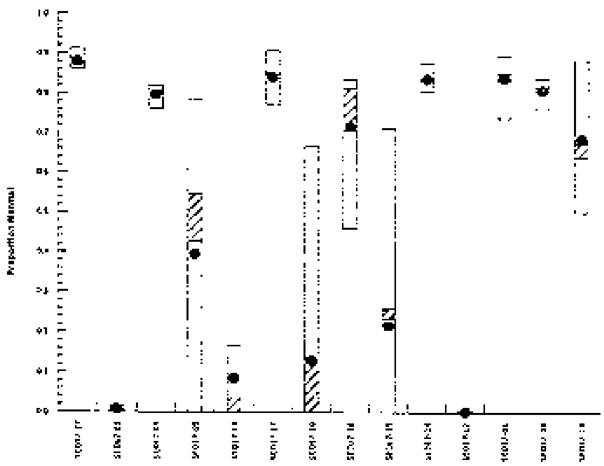
Proportion Normal Binomials

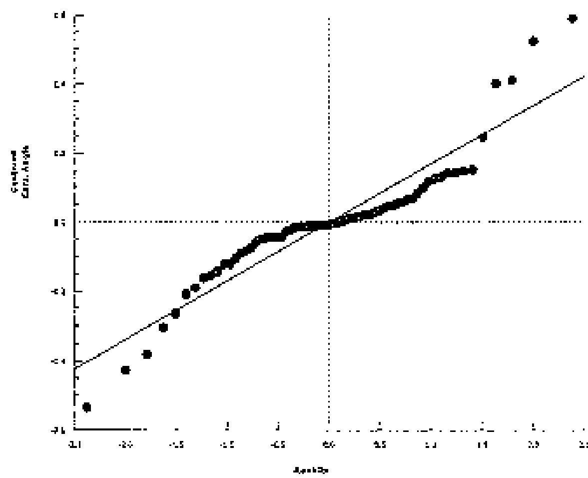
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	187/213	163/187	187/205	189/217	179/208
SED17-08	0/176	3/172	2/165	1/203	1/184
SED17-06	173/214	173/211	184/230	167/212	152/200
SED17-09	6/11	0/4	7/9	22/28	1/48
SED17-13	1/6	0/4	0/7	0/4	0/2
SED17-17	167/217	176/227	208/235	154/170	158/186
SED17-20	6/9	0/3	0/5	0/6	0/10
SED17-18	28/61	60/72	21/35	80/97	131/161
SED17-19	12/35	11/47	0/24	0/8	57/80
SED17-24	199/240	184/210	222/265	170/212	164/198
SED17-12	0/137	0/174	0/196	0/125	1/147
SED17-01	207/244	209/234	160/217	203/233	191/233
SED17-03	31/37	65/79	44/58	46/58	84/103
SED17-29	10/20	23/36	43/53	15/28	128/145

Echinoid Embryo-Larval Development Test — Nautilus Environmental

Analysis ID:	14-4425-7852	**Endpoint:**	Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:21	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





Analyst: [signature] July 24/17

Echinoid Embryo-Larval Development Test — **Nautilus Environmental**

Analysis ID:	05-3669-4693	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:22	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	12-0901-2008	**Test Type:**	Development-Survival	**Analyst:**	Yvonne Lam
Start Date:	26 May-17 15:55	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	30 May-17 16:25	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	4d 1h	**Source:**	San Diego Lab	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-27	15-8574-6565	05 May-17 17:00	15 May-17 10:30	20d 23h (5.5 °	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 23h (7.5 °		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 23h (8.5 °		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 23h (7.5 °		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 23h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 23h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 23h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 23h (5.5 °		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 23h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 23h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 23h (5.8 °		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 23h (7.2 °		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 23h (8.5 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-27	Sediment Sample	Golder	SED17-27		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	27.0%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
SED17-27		SED17-08	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-06	20	15	0	8	0.3138	Asymp	Non-Significant Effect
		SED17-09	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-13	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-17	22	15	0	8	0.5116	Asymp	Non-Significant Effect
		SED17-20	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-18	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-19	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-24	29	15	0	8	0.9687	Asymp	Non-Significant Effect
		SED17-12	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-01	35	15	0	8	0.9997	Asymp	Non-Significant Effect
		SED17-03	15	15	0	8	0.0402	Asymp	Significant Effect
		SED17-29	15	15	0	8	0.0402	Asymp	Significant Effect

Analysis ID:	05-3689-4693	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:22	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	10.30497	0.7926897	13	65.36	<0.0001	Significant Effect
Error	0.6792176	0.01212889	56			
Total	10.98418		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	54.66	27.69	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.9013	0.9526	<0.0001	Non-normal Distribution

Combined Proportion Normal Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-27	5	0.6582	0.6096	0.7068	0.68	0.5927	0.6873	0.01752	5.95%	0.0%
SED17-08	5	0.005091	0	0.01024	0.003636	0	0.01091	0.001854	81.44%	99.23%
SED17-06	5	0.6175	0.5647	0.6702	0.6291	0.5527	0.6691	0.01901	6.89%	6.19%
SED17-09	5	0.02618	0	0.06598	0.02182	0	0.08	0.01433	122.4%	96.02%
SED17-13	5	0.0007273	0	0.002747	0	0	0.003636	0.0007273	223.6%	99.89%
SED17-17	5	0.6276	0.5304	0.7249	0.6073	0.56	0.7564	0.03502	12.48%	4.64%
SED17-20	5	0.004364	0	0.01648	0	0	0.02182	0.004364	223.6%	99.34%
SED17-18	5	0.2327	0.03199	0.4335	0.2182	0.07636	0.4764	0.0723	69.47%	64.64%
SED17-19	5	0.05818	0	0.1649	0.04	0	0.2073	0.03843	147.7%	91.16%
SED17-24	5	0.6829	0.5772	0.7886	0.6691	0.5964	0.8073	0.03808	12.47%	-3.76%
SED17-12	5	0.0007273	0	0.002747	0	0	0.003636	0.0007273	223.6%	99.89%
SED17-01	5	0.7055	0.614	0.7969	0.7382	0.5818	0.76	0.03293	10.44%	-7.18%
SED17-03	5	0.1964	0.1029	0.2898	0.1673	0.1127	0.3055	0.03366	38.33%	70.17%
SED17-29	5	0.1593	0	0.3793	0.08364	0.03636	0.4655	0.07923	111.2%	75.8%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-27	5	0.9468	0.896	0.9975	0.9695	0.8787	0.9774	0.01827	4.32%	0.0%
SED17-08	5	0.06817	0.03308	0.1033	0.06034	0.03016	0.1046	0.01264	41.45%	92.8%
SED17-06	5	0.9043	0.8501	0.9585	0.916	0.8382	0.9579	0.01953	4.83%	4.48%
SED17-09	5	0.1371	0.01238	0.2619	0.1483	0.03016	0.2868	0.04494	73.27%	85.51%
SED17-13	5	0.03619	0.01943	0.05295	0.03016	0.03016	0.06034	0.006037	37.3%	96.18%
SED17-17	5	0.9162	0.8125	1.02	0.8935	0.8455	1.055	0.03736	9.12%	3.22%
SED17-20	5	0.05378	-0.0118	0.1194	0.03016	0.03016	0.1483	0.02362	98.21%	94.32%
SED17-18	5	0.4844	0.2428	0.7261	0.486	0.28	0.7618	0.08703	40.17%	48.83%
SED17-19	5	0.189	-0.03622	0.4141	0.2014	0.03016	0.4727	0.0811	95.97%	80.04%
SED17-24	5	0.9757	0.8586	1.093	0.9579	0.8824	1.116	0.04217	9.66%	-3.06%
SED17-12	5	0.03619	0.01943	0.05295	0.03016	0.03016	0.06034	0.006037	37.3%	96.18%
SED17-01	5	0.9991	0.9012	1.097	1.034	0.8676	1.059	0.03527	7.89%	-5.53%
SED17-03	5	0.4537	0.3367	0.5707	0.4213	0.3424	0.5856	0.04214	20.77%	52.08%
SED17-29	5	0.3757	0.09676	0.6546	0.2934	0.1919	0.7508	0.1005	59.79%	60.32%

Analysis ID:	05-3689-4693	Endpoint:	Combined Proportion Normal	CETIS Version:	CETISv1.8.7
Analyzed:	11 Jul-17 9:22	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes

Combined Proportion Normal Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	0.68	0.5927	0.68	0.6873	0.6509
SED17-08	0	0.01091	0.007273	0.003636	0.003636
SED17-06	0.6291	0.6291	0.6691	0.6073	0.5527
SED17-09	0.02182	0	0.02545	0.08	0.003636
SED17-13	0.003636	0	0	0	0
SED17-17	0.6073	0.64	0.7564	0.56	0.5745
SED17-20	0.02182	0	0	0	0
SED17-18	0.1018	0.2182	0.07636	0.2909	0.4764
SED17-19	0.04364	0.04	0	0	0.2073
SED17-24	0.7236	0.6691	0.8073	0.6182	0.5964
SED17-12	0	0	0	0	0.003636
SED17-01	0.7527	0.76	0.5818	0.7382	0.6945
SED17-03	0.1127	0.2364	0.16	0.1673	0.3055
SED17-29	0.03636	0.08364	0.1564	0.05455	0.4655

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	0.9695	0.8787	0.9695	0.9774	0.9387
SED17-08	0.03016	0.1046	0.08538	0.06034	0.06034
SED17-06	0.916	0.916	0.9579	0.8935	0.8382
SED17-09	0.1483	0.03016	0.1602	0.2868	0.06034
SED17-13	0.06034	0.03016	0.03016	0.03016	0.03016
SED17-17	0.8935	0.9273	1.055	0.8455	0.8602
SED17-20	0.1483	0.03016	0.03016	0.03016	0.03016
SED17-18	0.3248	0.486	0.28	0.5697	0.7618
SED17-19	0.2104	0.2014	0.03016	0.03016	0.4727
SED17-24	1.017	0.9579	1.116	0.9047	0.8824
SED17-12	0.03016	0.03016	0.03016	0.03016	0.06034
SED17-01	1.05	1.059	0.8676	1.034	0.9852
SED17-03	0.3424	0.5077	0.4115	0.4213	0.5856
SED17-29	0.1919	0.2934	0.4065	0.2357	0.7508

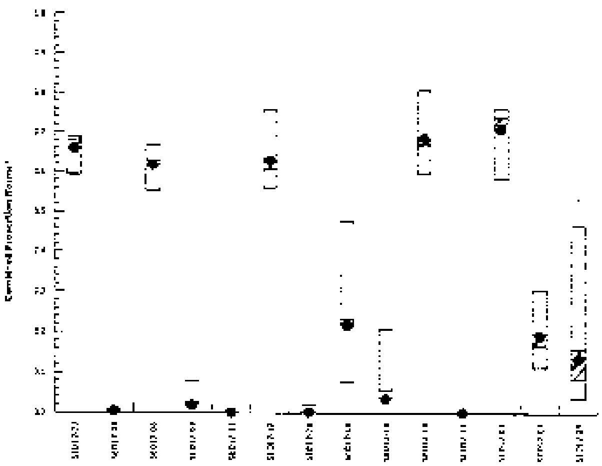
Combined Proportion Normal Binomials

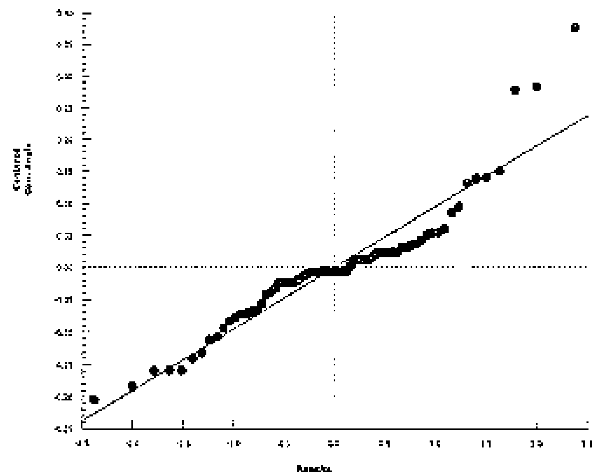
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	187/275	163/275	187/275	189/275	179/275
SED17-08	0/275	3/275	2/275	1/275	1/275
SED17-06	173/275	173/275	184/275	167/275	152/275
SED17-09	6/275	0/275	7/275	22/275	1/275
SED17-13	1/275	0/275	0/275	0/275	0/275
SED17-17	167/275	176/275	208/275	154/275	158/275
SED17-20	6/275	0/275	0/275	0/275	0/275
SED17-18	28/275	60/275	21/275	80/275	131/275
SED17-19	12/275	11/275	0/275	0/275	57/275
SED17-24	199/275	184/275	222/275	170/275	164/275
SED17-12	0/275	0/275	0/275	0/275	1/275
SED17-01	207/275	209/275	160/275	203/275	191/275
SED17-03	31/275	65/275	44/275	46/275	84/275
SED17-29	10/275	23/275	43/275	15/275	128/275

Echinoid Embryo-Larval Development Test **Nautilus Environmental**

Analysis ID:	05-3689-4693	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	11 Jul-17 9:22	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





NAUTILUS ENVIRONMENTAL
ATTN: Yvonne Lam
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 01-JUN-17
Report Date: 08-JUN-17 13:31 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L1936147
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Heather McKenzie
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936147-1	L1936147-2	L1936147-3	L1936147-4	L1936147-5
	Description					
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time					
	Client ID	CONT-OAM-0	08-OAM-0	06-OAM-0	09-OAM-0	13-OAM-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0767	0.239	0.246	0.187	0.147
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936147-6	L1936147-7	L1936147-8	L1936147-9	L1936147-10
	Description					
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time					
	Client ID	17-OAM-0	20-OAM-0	18-OAM-0	19-OAM-0	24-OAM-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.328	0.254	0.264	0.372	0.240
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1936147-11	L1936147-12	L1936147-13	L1936147-14	L1936147-15
		Description					
		Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
		Sampled Time					
		Client ID	12-OAM-0	01-OAM-0	03-OAM-0	29-OAM-0	27-OAM-0
Grouping	**Analyte**						
WATER							
Anions and Nutrients	Ammonia, Total (as N) (mg/L)		0.139	0.215	0.287	0.215	0.0792
	Sulphide as S (mg/L)						

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936147-16	L1936147-17	L1936147-18	L1936147-19	L1936147-20
	Description					
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time					
	Client ID	CONT-OS-0	08-OS-0	06-OS-0	09-OS-0	13-OS-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1936147-21	L1936147-22	L1936147-23	L1936147-24	L1936147-25
		Description					
		Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
		Sampled Time					
		Client ID	17-OS-0	20-OS-0	18-OS-0	19-OS-0	24-OS-0
Grouping	**Analyte**						
WATER							
Anions and Nutrients	Ammonia, Total (as N) (mg/L)						
	Sulphide as S (mg/L)		<0.018	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936147-26	L1936147-27	L1936147-28	L1936147-29	L1936147-30
	Description					
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time					
	Client ID	12-OS-0	01-OS-0	03-OS-0	29-OS-0	27-OS-0
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936147-31	L1936147-32	L1936147-33	L1936147-34	L1936147-35
	Description					
	Sampled Date	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17
	Sampled Time					
	Client ID	CONT-OAM-96	08-OAM-96	06-OAM-96	09-OAM-96	13-OAM-96
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0173	0.0573	0.0771	0.169	0.155
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936147-36	L1936147-37	L1936147-38	L1936147-39	L1936147-40
	Description					
	Sampled Date	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17
	Sampled Time					
	Client ID	17-OAM-96	20-OAM-96	18-OAM-96	19-OAM-96	24-OAM-96
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.235	0.258	0.152	0.314	0.0603
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936147-41	L1936147-42	L1936147-43	L1936147-44	L1936147-45
	Description					
	Sampled Date	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17
	Sampled Time					
	Client ID	12-OAM-96	01-OAM-96	03-OAM-96	29-OAM-96	27-OAM-96
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0415	0.0702	0.222	0.135	0.0070
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1936147-46	L1936147-47	L1936147-48	L1936147-49	L1936147-50
		Description					
		Sampled Date	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17
		Sampled Time					
		Client ID	CONT-OS-96	08-OS-96	06-OS-96	09-OS-96	13-OS-96
Grouping	**Analyte**						
WATER							
Anions and Nutrients	Ammonia, Total (as N) (mg/L)						
	Sulphide as S (mg/L)		<0.018	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936147-51	L1936147-52	L1936147-53	L1936147-54	L1936147-55
	Description					
	Sampled Date	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17
	Sampled Time					
	Client ID	17-OS-96	20-OS-96	18-OS-96	19-OS-96	24-OS-96
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936147-56	L1936147-57	L1936147-58	L1936147-59	L1936147-60
	Description					
	Sampled Date	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17	30-MAY-17
	Sampled Time					
	Client ID	12-OS-96	01-OS-96	03-OS-96	29-OS-96	27-OS-96
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
S2-T-COL-VA	Water	Total Sulphide by Colorimetric	APHA 4500-S2 Sulphide
This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

L1936147-COFC

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby ◯
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604 420.8773

Calgary ◯
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

Date______ Page 1 of 8

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By:

Sample Type: Grab ◯ OR Composite ◯

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Total Ammonia										Receipt Temperature (°C)
1	CONT-OAM-0	26/05/17			1x125mL container		✓										
2	08-OAM-0	26/05/17			1x125mL container		✓										
3	06-OAM-0	26/05/17			1x125mL container		✓										
4	09-OAM-0	26/05/17			1x125mL container		✓										
5	13-OAM-0	26/05/17			1x125mL container		✓										
6	17-OAM-0	26/05/17			1x125mL container		✓										
7	20-OAM-0	26/05/17			1x125mL container		✓										
8	18-OAM-0	26/05/17			1x125mL container		✓										
9	19-OAM-0	26/05/17			1x125mL container		✓										
10	24-OAM-0	26/05/17			1x125mL container		✓										

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples have been preserved.

Thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

9°C

RELINQUISHED BY (CLIENT)

Yvonne Lam (Printed Name) (Signature)

Nautilus Env (Company) 01/06/17 @ 8am (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

James (Printed Name) (Signature)

ALS (Company) 01/06/17 1810 (Date DD/MM/YY and Time)

Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole.

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020, Version 1.2, Revised by CC 2016/10/06

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby ◯
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary ◯
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

L1936147-COFC

Date______ Page 2 of 8

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By:

Sample Type: Grab ◯ OR Composite ◯

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Total Ammonia										Receipt Temperature (°C)
1	12-OAM-0	26/05/17			1x125mL container		✓										
2	01-OAM-0	26/05/17			1x125mL container		✓										
3	03-OAM-0	26/05/17			1x125mL container		✓										
4	29-OAM-0	26/05/17			1x125mL container		✓										
5	27-OAM-0	26/05/17			1x125mL container		✓										
6																	
7																	
8																	
9																	
10																	

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples have been preserved.

Thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

9°C

RELINQUISHED BY (CLIENT)

Yvonne Lam (Printed Name) (Signature)

Nautilus Env. (Company) 01/06/17 @ 16:00 (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

James (Printed Name) (Signature)

ALS (Company) 01/06/17 @ 8:10 (Date DD/MM/YY and Time)

Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020, Version 1.2, Revised by CC 2016/10/06

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

L1936147-COFC

Date______ Page 1 of 2

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By:

Sample Type: Grab OR Composite

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Total Sulphides										Receipt Temperature (°C)
1	CONT-OS-0	26/05/17			1x125mL container		✓										
2	08-OS-0	26/05/17			1x125mL container		✓										
3	06-OS-0	26/05/17			1x125mL container		✓										
4	09-OS-0	26/05/17			1x125mL container		✓										
5	13-OS-0	26/05/17			1x125mL container		✓										
6	17-OS-0	26/05/17			1x125mL container		✓										
7	20-OS-0	26/05/17			1x125mL container		✓										
8	18-OS-0	26/05/17			1x125mL container		✓										
9	19-OS-0	26/05/17			1x125mL container		✓										
10	24-OS-0	26/05/17			1x125mL container		✓										

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples have been preserved.

Thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

9°C

RELINQUISHED BY (CLIENT)

Yvonne Lam (Printed Name) (Signature)

Nautilus Env (Company) 01/06/17 @ 1600h (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

James (Printed Name) (Signature)

ALS (Company) 01/06/17 18:[illegible] (Date DD/MM/YY and Time)

Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole.

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020; Version 1.2; Revised by CC 2016/10/06

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby ◯
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary ◯
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

L1936147-COFC

Date______ Page 4 of 8

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By: **Sample Type:** Grab ◯ OR Composite ◯

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Total Sulphides										Receipt Temperature (°C)
1	12-OS-0	26/05/17			1x125mL container		✓										
2	01-OS-0	26/05/17			1x125mL container		✓										
3	03-OS-0	26/05/17			1x125mL container		✓										
4	29-OS-0	26/05/17			1x125mL container		✓										
5	27-OS-0	26/05/17			1x125mL container		✓										
6																	
7																	
8																	
9																	
10																	

ANALYSES REQUIRED

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples have been preserved.

Thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

9°C

RELINQUISHED BY (CLIENT)

Yvonne Lam (Printed Name) (Signature)

Nautilus Env. (Company) 01/06/17 @ 6:00 (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

James (Printed Name) (Signature)

ALS (Company) 01/06/17 18:00 (Date DD/MM/YY and Time)

Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole.

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

Form 020; Version 1.2. Revised by CC 2016/10/06

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

L1936147-COFC

Date______ Page 5 of 8

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By:

Sample Type: Grab OR Composite

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Total Ammonia										Receipt Temperature (°C)
1	CONT-OAM-96	30/05/17			1x125mL container		✓										
2	08-OAM-96	30/05/17			1x125mL container		✓										
3	06-OAM-96	30/05/17			1x125mL container		✓										
4	09-OAM-96	30/05/17			1x125mL container		✓										
5	13-OAM-96	30/05/17			1x125mL container		✓										
6	17-OAM-96	30/05/17			1x125mL container		✓										
7	20-OAM-96	30/05/17			1x125mL container		✓										
8	18-OAM-96	30/05/17			1x125mL container		✓										
9	19-OAM-96	30/05/17			1x125mL container		✓										
10	24-OAM-96	30/05/17			1x125mL container		✓										

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples have been preserved.

Thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

9°C

RELINQUISHED BY (CLIENT)

Yvonne Lam (Printed Name) (Signature)

Nautilus Envi (Company) 01/06/17 @1600h (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

James (Printed Name) (Signature)

ALS (Company) 01/06/17 18:00 (Date DD/MM/YY and Time)

Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole.

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Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
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T2H 2K1
Phone 403.253.7121

L1936147-COFC

Date____ Page 6 of 8

Report to:

Company	Nautilus Environmental
Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By: Sample Type: Grab OR Composite

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	ANALYSES REQUIRED: Total Ammonia										Receipt Temperature (°C)
1	12-OAM-96	30/05/17			1x125mL container		✓										
2	01-OAM-96	30/05/17			1x125mL container		✓										
3	03-OAM-96	30/05/17			1x125mL container		✓										
4	29-OAM-96	30/05/17			1x125mL container		✓										
5	27-OAM-96	30/05/17			1x125mL container		✓										
6																	
7																	
8																	
9																	
10																	

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples have been preserved.

Thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

9°C ✓

RELINQUISHED BY (CLIENT)

Yvonne Lam (Printed Name) (Signature)

Nautilus Env. (Company) 01/06/17 @ 1600h (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

James (Printed Name) (Signature)

ALS (Company) 01/06/17 18:00 (Date DD/MM/YY and Time)

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Date______ Page 7 of 8

Report to:

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Address	8664 Commerce Court
City/Prov/PC	Burnaby, BC
Contact	Yvonne Lam
Phone	604-420-8773
Email	yvonne@nautilusenvironmental.ca

Invoice To:

Company	(same)
Address	
City/Prov/PC	
Contact	
Phone	
Email	
PO No.	

Sample Collection By:

Sample Type: Grab ◯ OR Composite ◯

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Total Sulphides										Receipt Temperature (°C)
1	CONT-OS-96	30/05/17			1x125mL container		✓										
2	08-OS-96	30/05/17			1x125mL container		✓										
3	06-OS-96	30/05/17			1x125mL container		✓										
4	09-OS-96	30/05/17			1x125mL container		✓										
5	13-OS-96	30/05/17			1x125mL container		✓										
6	17-OS-96	30/05/17			1x125mL container		✓										
7	20-OS-96	30/05/17			1x125mL container		✓										
8	18-OS-96	30/05/17			1x125mL container		✓										
9	19-OS-96	30/05/17			1x125mL container		✓										
10	24-OS-96	30/05/17			1x125mL container		✓										

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples have been preserved.

Thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

9°C

RELINQUISHED BY (CLIENT)

Yvonne Lam (Printed Name) (Signature)

Nautilus Env. (Company) 01/06/17 @ 1600 (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

James (Printed Name) (Signature)

ALS (Company) 01/06/17 (Date DD/MM/YY and Time)

Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole.

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted. 8200

Form 020; Version 1.2; Revised by CC 2016/10/06

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

L1936147-COFC

Date______ Page 8 of 8

Report to:		Invoice To:	
Company	Nautilus Environmental	Company	(same)
Address	8664 Commerce Court	Address	
City/Prov/PC	Burnaby, BC	City/Prov/PC	
Contact	Yvonne Lam	Contact	
Phone	604-420-8773	Phone	
Email	yvonne@nautilusenvironmental.ca	Email	
		PO No.	

Sample Collection By:

Sample Type: Grab OR Composite

ANALYSES REQUIRED

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	Total Sulphides										Receipt Temperature (°C)
1	12-OS-096	30/05/17			1x125mL container		✓										
2	01-OS-096	30/05/17			1x125mL container		✓										
3	03-OS-096	30/05/17			1x125mL container		✓										
4	29-OS-096	30/05/17			1x125mL container		✓										
5	27-OS-096	30/05/17			1x125mL container		✓										
6																	
7																	
8																	
9																	
10																	

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Samples have been preserved.

Thanks!

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

9°C

RELINQUISHED BY (CLIENT)

Yvonne Lam (Printed Name) (Signature)

Nautilus Env. (Company) 31/06/17 @ 1600h (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

Jones (Printed Name) (Signature)

ALS (Company) 01/06/17 1810 (Date DD/MM/YY and Time)

Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole.

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Form 020; Version 1.2, Revised by CC 2016/10/06

Marine Amphipod Sediment Test Summary Sheet

Client: Golder

Work Order No.: 170470

Start Date: 26-May-17

Set up by: AWD/EC/JW

Sample Information:

Sample ID: Various - See Below

Sample Date: April, 2017: ~~25~~ JW, 26, ~~28~~, 29, 30

May, 2017: 1, 2, 4, 5

Date Received: 15-May-17

Sample Volume: 2 x 4L per sample

Test Organism Information:

Species: *E.estuarius*

Supplier: Northwestern Aquatic Sciences, OR

Date received: 24-May-17

Age or size (Day 0): 3-5 mm

Cadmium Reference Toxicant Results:

Reference Toxicant ID: EE50

Stock Solution ID: 16Cd01

Date Initiated: 26-May-17

96-h LC50 (95% CL): 6.2 (4.0 - 7.8) mg/L Cd

96-h LC50 Reference Toxicant Mean and Range: 7.9 (4.8 - 12.8) mg/L Cd CV (%): 28

Test Results:

Sample ID	Survival ± SD (%)	Avoidance ± SD (# amphipods/jar/day)	Reburial (%)
Control Sediment	97.0 ± 4.5	0.0 ± 0.0	100
SED17-08	94.0 ± 2.2	0.0 ± 0.0	100
SED17-06	94.0 ± 4.2	0.0 ± 0.0	100
SED17-09	36.0 ± 7.9*(a)(b)(c)	0.0 ± 0.0	100
SED17-13	40.0 ± 12.8*(a)(b)(c)	0.02 ± 0.04	100
SED17-17	92.0 ± 7.6	0.0 ± 0.0	100

SED17-20	62.0 ± 15.6*(a)	0.0 ± 0.0	98
SED17-18	91.0 ± 4.2	0.0 ± 0.0	100
SED17-19	57.0 ± 6.7*(a)(c)	0.0 ± 0.0	100
SED17-24	89.0 ± 11.4	0.0 ± 0.0	100
SED17-12	83.0 ± 11.5*	0.0 ± 0.0	100
SED17-01	77.0 ± 7.6*	0.0 ± 0.0	90
SED17-03	96.0 ± 4.2	0.0 ± 0.0	100
SED17-29	67.0 ± 15.2*(a)	0.0 ± 0.0	100
SED17-27	78.0 ± 13.5*	0.0 ± 0.0	87

* Asterics indicate sample(s) that is significantly different from the control sediment.
(a) indicates sample(s) that is significantly different from reference sediment SED17-24
(b) indicates sample(s) that is significantly different from reference sediment SED17-29
(c) indicates sample(s) that is significantly different from reference sediment SED17-27

Reviewed by: [signature]

Date reviewed: July 4, 2017

/

10-d Amphipod Sediment Toxicity Test Data Sheet

Marine Sediment 10-d Water Quality

Client: Golder Associates
Work Order No.: 170470

Start Date: 26-May-17
Termination Date: 5-Jun-17
Test Organism: *E. estuarius*

Temperature (°C)

Sample ID	Day										
	0	1	2	3	4	5	6	7	8	9	10
Control Sediment	14.5	14.5	14.5	15.0	15.0	14.5	15.0	15.0	15.0	15.0	15.0
SED17-08	14.5	14.5	14.5	15.0	15.0	14.5	15.0	15.0	15.0	15.0	15.0
SED17-06	14.5	14.5	14.5	15.0	15.0	14.5	15.0	15.0	15.0	15.0	15.0
SED17-09	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
SED17-13	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
SED17-17	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
SED17-20	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
SED17-18	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
SED17-19	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
SED17-24	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
SED17-12	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
SED17-01	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
SED17-03	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
SED17-29	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
SED17-27	14.5	14.5	14.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Technician Initials	[illegible]	[illegible]	[illegible]	JW	JW	JW	JW	JW	[illegible]	[illegible]	MLT

Salinity (ppt)

Sample ID	Day										
	0	1	2	3	4	5	6	7	8	9	10
Control Sediment	28	28	28	27	27	27	27	27	28	27	28
SED17-08	28	28	28	29	29 JW	~~28~~ 29	29	29	29	29	29
SED17-06	29	28	29	29	29	~~28~~ 29	29	29	29	29	29
SED17-09	28	29	29	29	29	29	29	29	29	29	29
SED17-13	28	29	29	28	29	29	29	29	29	29	29
SED17-17	28	28	29	29	29	29	29	29	29	29	29
SED17-20	29	29	29	28	28	29	29	29	29	29	29
SED17-18	28	29	29	29	29	29	29	29	29	29	29
SED17-19	28	29	28	29	29	29	29	29	29	29	29
SED17-24	29	29	29	29	29	29	29	29	29	29	29
SED17-12	28	28	29	29	29	29	29	29	29	28	29
SED17-01	28	28	28	29	29	29	29	29	29	29	29
SED17-03	28	28	28	28	29	28	28	28	28	28	29
SED17-29	28	28	28	28	28	28	29	29	29	29	29
SED17-27	28	28	28	28	28	28	28	28	28	28	28
Technician Initials	[illegible]	[illegible]	[illegible]	JW	JW	JW	JW	JW	[illegible]	[illegible]	MLT

Thermometer: USC #2 DO meter: 1/2 pH: 1/2 Salinity meter: 1/2

Comments:

Reviewed by: [signature] Date Reviewed: June 28, 2017

10-d Amphipod Sediment Toxicity Test Data Sheet

Marine Sediment 10-d Water Quality

Client: Golder Associates
Work Order No.: 170470

Start Date: 26-May-17
Termination Date: 5-Jun-17
Test Organism: *E. estuarius*

Dissolved oxygen (mg/L)

Sample ID	Day 0	1	2	3	4	5	6	7	8	9	10
Control Sediment	7.8	8.0	8.0	8.2	8.0	8.1	7.8	8.1	8.1	7.9	7.8
SED17-08	7.9	8.0	7.9	8.2	8.0	8.1	7.8	8.0	8.0	8.0	7.8
SED17-06	7.9	8.1	8.0	8.2	8.1	8.1	7.8	8.0	8.1	8.0	7.8
SED17-09	7.8	8.0	8.0	8.3	8.1	8.1	7.8	7.6	7.9	7.8	7.3
SED17-13	7.9	8.1	8.1	8.2	8.0	8.1	7.8	7.7	8.0	8.0	7.8
SED17-17	7.9	8.0	8.0	8.2	8.0	8.1	7.9	7.8	8.0	7.9	7.8
SED17-20	7.9	8.1	8.1	8.2	8.1	8.2	7.8	7.8	7.9	8.0	7.7
SED17-18	7.9	8.1	8.1	8.2	8.0	8.2	7.8	7.8	8.0	8.0	7.8
SED17-19	7.9	8.0	8.1	8.2	8.0	8.2	7.8	7.8	8.1	7.9	7.9
SED17-24	7.8	8.0	8.1	8.2	8.0	8.1	7.8	7.8	8.0	8.0	7.9
SED17-12	7.9	8.1	8.0	8.3	8.1	8.1	7.8	7.8	8.1	7.9	7.9
SED17-01	7.9	8.0	8.1	8.3	8.2	8.1	8.0	7.8	8.0	8.0	7.9
SED17-03	7.9	8.0	8.1	8.2	8.1	8.1	7.8	7.9	8.0	8.0	7.9
SED17-29	7.9	8.0	8.0	8.2	8.1	8.1	8.0	7.8	8.0	7.9	7.9
SED17-27	7.9	8.0	8.1	8.2	8.1	8.1	7.9	7.8	8.0	7.9	7.9
Technician Initials	A	A	A	JW	JW	JW	JW	JW	A	A	MQ

pH

Sample ID	Day 0	1	2	3	4	5	6	7	8	9	10
Control Sediment	7.8	7.7	7.8	7.6	7.6	7.6	7.6	7.5	7.7	7.6	7.7
SED17-08	7.7	7.6	7.7	7.8	7.8	7.8	7.7	7.7	7.7	7.7	7.9
SED17-06	7.8	7.7	7.7	7.8	7.8	7.8	7.8	7.7	7.8	7.7	7.9
SED17-09	7.8	7.7	7.8	7.6	7.6	7.6	7.7	7.6	7.7	7.8	8.0
SED17-13	7.7	7.8	7.7	7.6	7.7	7.7	7.7	7.6	7.8	7.8	7.9
SED17-17	7.8	7.7	7.8	7.8	7.8	7.8	7.8	7.7	7.8	7.7	7.9
SED17-20	7.7	7.7	7.8	7.7	7.7	7.8	7.8	7.7	7.7	7.8	8.0
SED17-18	7.8	7.7	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.7	8.0
SED17-19	7.8	7.7	7.7	7.8	7.9	7.9	7.9	7.8	7.9	7.8	8.0
SED17-24	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.7	7.8	7.8	8.0
SED17-12	7.7	7.8	7.7	7.7	7.7	7.8	7.7	7.7	7.8	7.7	7.9
SED17-01	7.8	7.8	7.7	7.8	7.97	7.8	7.7	7.7	7.8	7.7	7.9
SED17-03	7.8	7.8	7.8	7.9	7.9	7.9	7.7	7.6	7.7	7.8	7.9
SED17-29	7.8	7.8	7.8	7.7	7.7	7.8	7.8	7.8	7.8	7.8	7.8
SED17-27	7.8	7.8	7.8	7.6	7.7	7.7	7.6	7.6	7.8	7.7	7.8
Technician Initials	A	A	A	JW	JW	JW	JW	JW	A	A	MQ

Thermometer: Wall #2   DO meter: 1/2   pH: 1/2   Salinity meter: 1/2

Comments:

Reviewed by: [signature]   Date Reviewed: June 28, 2017

10-d Amphipod Sediment Toxicity Test Data Sheet
Marine Sediment 10-d Emergence and Final Survival

Client: Golder Associates
Work Order No.: 170470

Start Date: 26-May-17
Termination Date: 5-Jun-17
Test Organism: *E. estuarius*

Sample ID: Control Sediment

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality: Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	20	0	0	0	15.0	28	7.8	7.7
B			0	0	0	0	0			0	20	0	0	0	15.0	28	7.9	7.8
C			0	0	0	0	0			0	19	0	1	0	15.0	28	7.9	7.8
D			0	0	0	0	0			0	JW ~~19~~ 18	0	0	JW ~~1~~ 2	15.0	28	7.9	7.8
E			0	0	0	0	0			0	20	0	0	0	15.0	28	7.9	7.8
Initials	[illegible]	[illegible]	JW	JW	JW	JW	JW	[illegible]	[illegible]	JW	JW	JW	JW	JW	MLT	MLT	MLT	MLT

Comments:

Sample ID: SED17- 08

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality: Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	19	0	0	1	15.0	30	7.7	8.0
B			0	0	0	0	0			0	18	0	1	1	15.0	30	7.7	7.9
C			0	0	0	0	0			0	19	0	0	1	15.0	29	7.8	8.0
D			0	0	0	0	0			0	19	0	0	1	15.0	29	7.8	7.9
E			0	0	0	0	0			0	19	0	0	1	15.0	30	7.9	7.9
Initials	[illegible]	[illegible]	JW	JW	JW	JW	JW	[illegible]	[illegible]	JW	JW	JW	JW	JW	MLT	MLT	MLT	MLT

Thermometer: CER #2 DO meter: 1 pH: 1 Salinity meter: 1

Comments:

Reviewed by: [signature] Date Reviewed: June 28, 2017

10-d Amphipod Sediment Toxicity Test Data Sheet

Marine Sediment 10-d Emergence and Final Survival

Client: Golder Associates
Work Order No.: 170470

Start Date: 26-May-17
Termination Date: 5-Jun-17
Test Organism: *E. estuarius*

Sample ID: SED17-06

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	20	0	0	0	15.0	29	7.8	8.0
B			0	0	0	0	0			0	19	0	JW ~~0~~ 1	0	15.0	29	7.8	8.0
C			0	0	0	0	0			0	18	0	1	1	15.0	29	7.8	8.0
D			0	0	0	0	0			0	18	0	0	JW ~~3~~ 2	15.0	29	7.8	8.0
E			0	0	0	0	0			0	19	0	1	0	15.0	29	7.8	8.0
Initials			JW	JW	JW	JW	JW			JW	JW	JW	JW	JW	MLT	MLT	MLT	MLT

Comments:

Sample ID: SED17-09

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	7 ①	0	1	12	15.0	30	7.7	8.1
B			0	0	0	0	0			0	9 ②	0	1	10	15.0	29	7.6	8.1
C			0	0	0	0	0			0	5	0	1	15	15.0	30	7.7	8.1
D			0	0	0	0	0			0	8	0	0	12	15.0	30	7.7	8.1
E			0	0	0	0	0			0	6	0	1	13	15.0	29	7.6	8.2
Initials			JW	JW	JW	JW	JW			JW	JW	JW	JW	JW	MLT	MLT	MLT	MLT

Thermometer: CER #2 DO meter: 1 pH: 1 Salinity meter: 1

Comments: ① Checked by MLT ② Checked by KL oily sheen on water

Reviewed by: [signature] Date Reviewed: June 28 2017

10-d Amphipod Sediment Toxicity Test Data Sheet
Marine Sediment 10-d Emergence and Final Survival

Client: Golder Associates
Work Order No.: 170470

Start Date: 26-May-17
Termination Date: 5-Jun-17
Test Organism: *E. estuarius*

Sample ID: SED17- 13

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality: Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	5 ①	0	0	15	15.0	29	7.6	8.0
B			0	0	0	0				0	10	0	0	10	15.0	29	7.5	8.1
C			0	0	0	0	0			0	8	0	0	12	15.0	29	7.5	8.1
D			0	0	0	0	0			0	6 ②	0	2	12	15.0	29	7.6	8.1
E			0	0	0	0	0			0	11	0	0	9	15.0	29	7.6	8.2
Initials	A	A	JW	JW	JW	JW	JW	A	A	JW	JW	JW	JW	JW	MLJ	MLJ	MLJ	MLJ

Comments: ① checked by KL oily sheen on water ② checked by KJL

Sample ID: SED17- 17

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality: Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	17	0	0	3	15.0	29	7.8	8.0
B			0	0	0	0	0			0	17	0	1	2	15.0	29	7.8	8.0
C			0	0	0	0	0			0	20	0	0	0	15.0	29	7.9	7.9
D			0	0	0	0	0			0	18	0	1	1	15.0	29	7.9	7.9
E			0	0	0	0	0			0	20	0	0	0	15.0	29	7.9	7.8
Initials	A	A	JW	JW	JW	JW	JW	A	A	JW	JW	JW	JW	JW	MLJ	MLJ	MLJ	MLJ

Thermometer: CER #2 DO meter: 1 pH: 1 Salinity meter: 1

Comments:

Reviewed by: [signature] Date Reviewed: June 28, 2017

10-d Amphipod Sediment Toxicity Test Data Sheet

Marine Sediment 10-d Emergence and Final Survival

Client: Golder Associates
Work Order No.: 170470

Start Date: 26-May-17
Termination Date: 5-Jun-17
Test Organism: *E. estuarius*

Sample ID: SED17- 20

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality: Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	17	0	0	3	15.0	29	7.6	8.1
B			0	0	0	0	0			0	11 ①	0	1	8	15.0	29	7.6	8.1
C			0	0	0	0	0			0	14 ~~15~~ ②	0	0	6 ~~5~~ MG	15.0	29	7.6	8.2
D			0	0	0	0	0			0	9 ①	0	0	11	15.0	29	7.6	8.1
E			0	0	0	0	0			0	11 ①	0	0	9	15.0	29	7.6	8.1
Initials	[illegible]	[illegible]	JW	JW	JW	JW	JW	[illegible]	[illegible]	JW	MG	MG	MG	MG	MG	MG	MG	MG

Comments:

Sample ID: SED17- 18

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality: Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	19	0	0	1	15.0	29	7.8	8.1
B		[illegible]	0	0	0	0	0			0	17	0	0	3	15.0	29	7.8	8.1
C			0	0	0	0	0			0	18	0	0	2	15.0	29	7.8	8.1
D			0	0	0	0	0			0	18	0	0	2	15.0	29	7.8	8.2
E			0	0	0	0	0			0	19	0	0	1	15.0	29	7.9	8.2
Initials	[illegible]	[illegible]	JW	JW	JW	JW	JW	[illegible]	[illegible]	JW	MG	MG	MG	MG	MG	MG	MG	MG

Thermometer: CER #2 DO meter: 1 pH: 1 Salinity meter: 1

Comments: ① checked by KL ② checked by JW

Reviewed by: [illegible] Date Reviewed: June 28, 2017

10-d Amphipod Sediment Toxicity Test Data Sheet
Marine Sediment 10-d Emergence and Final Survival

Client: Golder Associates
Work Order No.: 170470
Start Date: 26-May-17
Termination Date: 5-Jun-17
Test Organism: *E. estuarius*

Sample ID: SED17- 19

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	~~8~~ 10 ①	0	0	10	15.0	29	7.7	8.0
B	|	|	0	0	0	0	0	|	|	0	10 ①	0	0	10	15.0	29	7.7	7.9
C	|	|	0	0	0	0	0	|	|	0	~~10~~ 12 ①	0	0	~~10~~ 8	15.0	29	7.8	8.1
D	|	|	0	0	0	0	0	|	|	0	13 ①	0	2	5	15.0	29	7.8	8.1
E	|	|	0	0	0	0	0	|	|	0	12 ①	0	1	7	15.0	29	7.8	8.1
Initials	A	A	JW	JW	JW	JW	JW	A	A	JW	KJL	KJL	KJL	KJL	MLT	MLT	MLT	MLT

Comments: ① checked by KL

Sample ID: SED17- 24

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	16 ①	0	0	4	15.0	29	7.8	7.8
B	|	|	0	0	0	0	0	|	|	0 ~~5~~	~~15~~ 14 ②	JW 0	4	~~0~~ JW 1	15.0	29	7.9	7.9
C	|	|	0	0	0	0	0	|	|	0	18	0	0	2	15.0	29	7.8	7.9
D	|	|	0	0	0	0	0	|	|	0	20	0	0	0	15.0	29	7.8	7.9
E	|	|	0	0	0	0	0	|	|	0	20	0	0	0	15.0	29	7.9	7.9
Initials	A	A	JW	JW	JW	JW	JW	A	A	JW	JW/KJL	JW/KJL	JW/KJL	JW/KJL	MLT	MLT	MLT	MLT

Thermometer: CER #2　DO meter: 1　pH: 1　Salinity meter: 1

Comments: ① checked by KL ② checked by JW

Reviewed by: [signature]　Date Reviewed: June 28, 2017

10-d Amphipod Sediment Toxicity Test Data Sheet

Marine Sediment 10-d Emergence and Final Survival

Client: Golder Associates
Work Order No.: 170470

Start Date: 26-May-17
Termination Date: 5-Jun-17
Test Organism: *E. estuarius*

Sample ID: SED17- 12

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality: Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	19	0	0	1	15.0	29	7.8	7.8
B			0	0	0	0	0			0	16	0	1	3	15.0	29	7.8	7.8
C			0	0	0	0	0			0	17	0	0	3	15.0	29	7.8	7.8
D			0	0	0	0	0			0	13 (1)	0	0	7	15.0	29	7.9	7.9
E			0	0	0	0	0			0	18	0	0	2	15.0	29	7.9	7.8
Initials	A	A	JW	JW	JW	JW	JW	A	A	JW	MLT	MLT	MLT	MLT	MLT	MLT	MLT	MLT

Comments: (1) checked by KL

Sample ID: SED17- 01

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality: Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	(2) ~~14~~ 14	3	0	3 ~~10~~ 4	15.0	29	7.9	7.8
B			0	0	0	0	0			0	14	1	0	6	15.0	29	7.8	7.8
C			0	0	0	0	0			0	17	1	0	3	15.0	29	7.8	7.8
D			0	0	0	0	0			0	(1) 15	2	3	2	15.0	29	7.9	7.8
E			0	0	0	0	0			0	17	0	1	2	15.0	29	7.9	7.8
Initials	A	A	JW	JW	JW	JW	JW	A	A	JW	K	K	K	K	MLT	MLT	MLT	MLT

Thermometer: CER #2 DO meter: 1 pH: 1 Salinity meter: 1

Comments: (1) checked by ~~KL~~ JW

Reviewed by: [signature] Date Reviewed: June 28, 2017

10-d Amphipod Sediment Toxicity Test Data Sheet
Marine Sediment 10-d Emergence and Final Survival

Client: Golder Associates
Work Order No.: 170470

Start Date: 26-May-17
Termination Date: 5-Jun-17
Test Organism: *E. estuarius*

Sample ID: SED17- 03

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality: Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	19	0	0	1	15.0	29	7.8	8.0
B			0	0	0	0	0			0	20	0	0	0	15.0	29	7.8	8.0
C			0	0	0	0	0			0	19	0	0	1	15.0	29	7.8	8.0
D			0	0	0	0	0			0	20	0	0	0	15.0	29	7.8	8.0
E			0	0	0	0	0			0	18	0	0	2	15.0	29	7.8	7.9
Initials	A	A	JW	JW	JW	JW	JW	A	A	JW	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ

Comments:

Sample ID: SED17- 39

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality: Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	17	0	0	3	15.0	29	7.8	8.0
B			0	0	0	0	0			0	11②	0	0	9	15.0	29	7.9	7.9
C			0	0	0	0	0			0	16	0	1	3	15.0	29	7.9	8.0
D			0	0	0	0	0			0	13①	0	0	7	15.0	29	7.8	8.1
E			0	0	0	0	0			0	10①	0	0	10	15.0	29	7.9	8.0
Initials	A	A	JW	JW	JW	JW	JW	A	A	JW	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ	MLJ

Thermometer: CER #2 DO meter: 1 pH: 1 Salinity meter: 1

Comments: ① checked by KL ② checked by KJL

Reviewed by: [signature] Date Reviewed: June 28, 2017

10-d Amphipod Sediment Toxicity Test Data Sheet
Marine Sediment 10-d Emergence and Final Survival

Client: Golder Associates
Work Order No.: 170470

Start Date: 26-May-17
Termination Date: 5-Jun-17
Test Organism: *E. estuarius*

Sample ID: SED17- 27

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A	0	0	0	0	0	0	0	0	0	0	~~20~~ ~~8~~	0 ~~1~~	0 ~~8~~	0 ~~8~~	15.0	29	7.7	7.8
B			0	0	0	0	0			0	13 ①	5	2	~~7~~ 0	15.0	29	7.8	7.8
C			0	0	0	0	0			0	14	2	4	2	15.0	29	7.8	7.8
D			0	0	0	0	0			0	15	2	5	0	15.0	29	7.9	7.9
E			0	0	0	0	0			0	16	0	1	3	15.0	29	7.8	7.8
Initials	A	A	JW	JW	JW	JW	JW	A	A	JW	K	K	K	K	MLT	MLT	MLT	MLT

Comments: ① Checked by JW

Sample ID: ~~SED17-~~ JW

Rep	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 10 survival	No. failing to rebury	No. dead	No. missing	Day 10 Water Quality Temp (°C)	Sal (ppt)	DO (mg/L)	pH
A																		
B																		
C																		
D																		
E																		
Initials																		

Thermometer: CEP #2 DO meter: 1 pH: 1 Salinity meter: 1.

Comments:

Reviewed by: [signature] Date Reviewed: June 28, 2017

10-d Amphipod Test - Summary of Daily Emergence
Client: Golder
WO #: 170470

Sample ID	Rep	1	2	3	4	5	6	7	8	9	10	Mean Daily Emergence	Mean Emergence	Standard Deviation
Control Sediment	A	0	0	0	0	0	0	0	0	0	0	0.0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-08	A	0	0	0	0	0	0	0	0	0	0	0.0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-06	A	0	0	0	0	0	0	0	0	0	0	0.0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-09	A	0	0	0	0	0	0	0	0	0	0	0.0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-13	A	0	0	0	0	0	0	0	0	0	0	0.0	0.02	0.04
	B	0	0	0	0	0	0	1	0	0	0	0.1		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-17	A	0	0	0	0	0	0	0	0	0	0	0.0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-20	A	0	0	0	0	0	0	0	0	0	0	0.0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-16	A	0	0	0	0	0	0	0	0	0	0	0.0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-19	A	0	0	0	0	0	0	0	0	0	0	0.0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-24	A	0	0	0	0	0	0	0	0	0	0	0.0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-12	A	0	0	0	0	0	0	0	0	0	0	0.0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-01	A	0	0	0	0	0	0	0	0	0	0	0.0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-03	A	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-29	A	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		
SED17-27	A	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	B	0	0	0	0	0	0	0	0	0	0	0		
	C	0	0	0	0	0	0	0	0	0	0	0		
	D	0	0	0	0	0	0	0	0	0	0	0		
	E	0	0	0	0	0	0	0	0	0	0	0		

Note
Mean daily emergence is the average number of amphipods emerging from the sediment per replicate per day.

June 28/17

Marine amphipod Sediment Test - Ammonia

Client : Golder Associates
W.O.: 170470

Start Date: 26-May-17
End Date: 5-Jun-17
Species: *E. estuarius*

Overlying Ammonia

	Sample ID	Temperature (°C)	pH	Salinity (ppt)	Total Ammonia as Nitrogen (mg/L)	pKa	Unionized Ammonia (mg/L)
Day 0							
	Control Sediment	15	7.6	29	0.0282	9.737	0.000
	SED17-08	15	7.7	29	0.747	9.737	0.007
	SED17-06	15	7.6	29	0.773	9.737	0.006
	SED17-09	15	7.7	29	0.219	9.737	0.002
	SED17-13	15	7.7	29	0.120	9.737	0.001
	SED17-17	15	7.7	29	0.545	9.737	0.005
	SED17-20	15	7.7	29	0.295	9.737	0.003
	SED17-18	15	7.7	29	0.446	9.737	0.004
	SED17-19	15	7.8	29	0.477	9.737	0.005
	SED17-24	15	7.7	29	0.497	9.737	0.005
	SED17-12	15	7.7	28	0.377	9.737	0.003
	SED17-01	15	7.7	28	0.421	9.737	0.004
	SED17-03	15	7.6	28	1.480	9.737	0.011
	SED17-29	15	7.8	29	0.581	9.737	0.007
	SED17-27	15	7.6	29	0.271	9.737	0.002
Day 10							
	Control Sediment	15	7.7	28	0.0282	9.737	0.000
	SED17-08	15	7.9	30	0.478	9.737	0.007
	SED17-06	15	8.0	29	0.762	9.737	0.014
	SED17-09	15	8.1	29	0.983	9.737	0.022
	SED17-13	15	8.1	29	0.726	9.737	0.016
	SED17-17	15	8.1	29	0.518	9.737	0.012
	SED17-20	15	8.2	29	1.890	9.737	0.053
	SED17-18	15	8.1	29	0.443	9.737	0.010
	SED17-19	15	8.1	29	6.390	9.737	0.144
	SED17-24	15	8	29	6.890	9.737	0.124
	SED17-12	15	7.8	29	0.0588	9.737	0.001
	SED17-01	15	7.9	29	0.368	9.737	0.005
	SED17-03	15	8.0	29	3.41	9.737	0.061
	SED17-29	15	8.0	29	0.949	9.737	0.017
	SED17-27	15	7.8	29	0.613	9.737	0.007

Table of PKa values

Temperature (°C)	TDS (mg/L)			Salinity (g/kg)		
	0	250	2000	10	20	30
12	9.662	9.699	9.754	9.788	9.819	9.837
15	9.564	9.601	9.655	9.688	9.719	**9.737**
18	9.465	9.502	9.557	9.588	9.619	9.636
20	9.401	9.438	9.492	9.523	9.554	9.571
22		9.391				
23	9.307	9.344	9.398	9.426	9.459	9.476
25	9.246	9.283	9.337	9.366	9.397	9.414

July 4, 2017

Marine amphipod Sediment Test - Ammonia

Client : Golder Associates
W.O.: 170470

Start Date: 26-May-17
End Date: 5-Jun-17
Species: *E. estuarius*

Interstitial Ammonia

	Sample ID	Temperature (°C)	pH	Salinity (ppt)	Total Ammonia as Nitrogen (mg/L)	pKa	Unionized Ammonia (mg/L)
Day 0							
	Control Sediment	15	7.3	29	2.93	9.737	0.011
	SED17-08	15	7.0	29	9.18	9.737	0.017
	SED17-06	15	7.2	29	2.69	9.737	0.008
	SED17-09	15	7.5	29	1.09	9.737	0.006
	SED17-13	15	7.7	29	1.12	9.737	0.010
	SED17-17	15	7.2	29	4.01	9.737	0.012
	SED17-20	15	7.5	29	2.04	9.737	0.012
	SED17-18	15	7.4	29	2.44	9.737	0.011
	SED17-19	15	7.5	29	3.43	9.737	0.020
	SED17-24	15	7.3	29	2.42	9.737	0.009
	SED17-12	15	7.4	29	1.25	9.737	0.006
	SED17-01	15	7.2	29	2.26	9.737	0.007
	SED17-03	15	7.2	29	4.83	9.737	0.014
	SED17-29	15	7.5	29	2.74	9.737	0.016
	SED17-27	15	7.1	29	0.885	9.737	0.002
Day 10							
	Control Sediment	15	8.0	27	0.117	9.737	0.002
	SED17-08	15	7.2	29	1.43	9.737	0.004
	SED17-06	15	7.4	29	2.25	9.737	0.010
	SED17-09	15	7.2	29	4.06	9.737	0.012
	SED17-13	15	7.2	29	2.31	9.737	0.007
	SED17-17	15	7.2	29	2.78	9.737	0.008
	SED17-20	15	7.2	30	5.81	9.737	0.017
	SED17-18	15	6.9	30	4.18	9.737	0.006
	SED17-19	15	7.1	29	13.1	9.737	0.030
	SED17-24	15	7.1	29	3.91	9.737	0.009
	SED17-12	15	7.1	29	1.96	9.737	0.005
	SED17-01	15	7.0	29	2.05	9.737	0.004
	SED17-03	15	7.5	29	6.38	9.737	0.037
	SED17-29	15	7.2	29	3.41	9.737	0.010
	SED17-27	15	6.9	29	0.835	9.737	0.001

Table of PKa values

Temperature (°C)	TDS (mg/L)			Salinity (g/kg)		
	0	250	2000	10	20	30
12	9.662	9.699	9.754	9.788	9.819	9.837
15	9.564	9.601	9.655	9.688	9.719	**9.737**
18	9.465	9.502	9.557	9.588	9.619	9.636
20	9.401	9.438	9.492	9.523	9.554	9.571
22		9.391				
23	9.307	9.344	9.398	9.426	9.459	9.476
25	9.246	9.283	9.337	9.366	9.397	9.414

July 4, 2017

Nautilus Environmental
Sediment Toxicity Test - Water Quality Data For Ammonia

Client : Golder Associates

Work Order No: 140470 - 140471

Species : *E. estuarius / N. arenaceodentata*

Sample Type: Ammonia - overlying

Date Measured: 26-May-17

	Sample ID	Salinity (ppt)	pH	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)	Tech Init
	Control Sediment	29	7.6	0.0282	0.000	EC
1	SED17- 02	29	7.7	0.747	0.007	
2	SED17- 06	29	7.6	0.773	0.006	
3	SED17- 09	29	7.7	0.219	0.002	
4	SED17- 13	29	7.7	0.120	0.001	
5	SED17- 17	29	7.7	0.545	0.005	
6	SED17- 20	29	7.7	0.295	0.003	
7	SED17- 18	29	7.7	0.446	0.004	
8	SED17- 19	29	7.8	0.477	0.005	
9	SED17- 24	29	7.7	0.497	0.005	
10	SED17- 12	28	7.7	0.377	0.003	
11	SED17- 01	28	7.7	0.421	0.004	
12	SED17- 03	28	7.6	1.48	0.011	
13	SED17- 29	29	7.8	0.581	0.007	
14	SED17- 27	29	7.6	0.271	0.002	
15						

Comments: 1. pH and salinity values were obtained from composites JW of all replicates.

2. Total Ammonia measurements were done by ALS. Results ~~were~~ are JW enclosed in the data package.

Reviewed by: [signature]

Date Reviewed: June 28, 2017

Nautilus Environmental
Water Quality Data For Ammonia

Client : Golder Associates

Species : E. estuarius

Work Order No: 140470

Sample Type: Ammonia - overlying

Date Measured: June 5/17

Date	Sample ID	Temperature °C	Salinity (ppt)	pH	Total Ammonia as N (mg/L)	Unionized Ammonia (mg/L)	Tech. Init.
June 5/17	Control Sediment	15.0	28	7.7	0.0213	0.000	JW
	SED 17 - 08		30	7.9	0.478	0.007	
	06		29	8.0	0.762	0.014	
	09		29	8.1	0.983	0.022	
	13		29	8.1	0.726	0.016	
	17		29	8.1	0.518	0.012	
	20		29	8.2	1.89	0.053	
	18		29	8.1	0.443	0.010	
	19		29	8.1	6.39	0.144	
	24		29	8.0	6.89	0.124	
	12		29	7.8	0.0588	0.001	
	01		29	7.9	0.368	0.005	
	03		29	8.0	3.41	0.061	
	29		29	8.0	0.949	0.017	
↓	↓ 27	↓	29	7.8	0.613	0.007.	↓

Ammonia Salicylate Lot #: n/a

Ammonia Cyanurate Lot #: n/a

Comments: ① Total ammonia measurements were done by ALS. Results are enclosed in the data package.
② pH and salinity values were obtained from composite of all replicates.

Reviewd by: [signature]

Date Reviewed: July 4, 2017

Nautilus Environmental
Water Quality Data For Ammonia

Client: Golder Associates

Work Order No: 140470

Species: E. estuarius

Sample Type: Ammonia - Interstitial.

Date Measured: June 5/17

Date	Sample ID	Temperature °C	Salinity (ppt)	pH	Total Ammonia as N (mg/L)	Unionized Ammonia (mg/L)	Tech. Init.
June 5/17	Control Sediment	15.0	27	8.0	0.117	0.002	JW
↓	SED 17 - 08	↓	29	7.2	1.43	0.004	↓
	06		29	7.4	2.25	0.010	
	09		29	7.2	4.06	0.012	
	13		29	7.2	2.31	0.007	
	17		29	7.2	2.78	0.008	
	20		29	7.2	5.81	0.017	
	18		29	6.9	4.18	0.006	
	19		29	7.1	13.1	0.030	
	24		29	7.1	3.91	0.009	
	12		29	7.1	1.96	0.005	
	01		29	7.0	2.05	0.004	
	03		29	7.5	6.38	0.037	
	29		29	7.2	3.41	0.010	
↓	↓ 27	↓	29	6.9	0.835	0.001	↓

Ammonia Salicylate Lot #: n/a

Ammonia Cyanurate Lot #: n/a

Comments: (1) Total ammonia measurements were done by ALS. Results are enclosed in the data package.

Reviewd by: [signature]

Date Reviewed: July 4, 2017

CETIS Summary Report

Report Date: 21 Jun-17 11:40 (p 1 of 3)
Test Code: 170470 | 17-4459-1101

Eohaustorius 10-d Survival and Reburial Sediment Test — **Nautilus Environmental**

Batch ID:	20-2186-1230	**Test Type:**	Survival-Reburial	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	EC/EPS 1/RM/35	**Diluent:**	Natural seawater
Ending Date:	05 Jun-17	**Species:**	Eohaustorius estuarius	**Brine:**	
Duration:	10d 0h	**Source:**	Northwestern Aquatic Science, OR	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sed	01-7363-6469	26 May-17	26 May-17	NA	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9690-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sed	Sediment Sample	Golder	Control Sediment		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Analyst: JW QA: June 28/17

Eohaustorius 10-d Survival and Reburial Sediment Test — Nautilus Environmental

Reburial Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sed	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-08	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-06	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-09	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-13	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-17	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-20	5	0.9818	0.9313	1.032	0.9091	1	0.01818	0.04066	4.14%	1.82%
SED17-18	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-19	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-24	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-12	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-01	5	0.9044	0.8032	1.006	0.7857	1	0.03646	0.08153	9.01%	9.56%
SED17-03	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-29	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-27	5	0.8678	0.6727	1.063	0.6154	1	0.07028	0.1571	18.11%	13.22%

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sed	5	0.97	0.9145	1	0.9	1	0.02	0.04472	4.61%	0.0%
SED17-08	5	0.94	0.9122	0.9678	0.9	0.95	0.01	0.02236	2.38%	3.09%
SED17-06	5	0.94	0.8881	0.9919	0.9	1	0.01871	0.04183	4.45%	3.09%
SED17-09	5	0.35	0.2518	0.4482	0.25	0.45	0.03536	0.07906	22.59%	63.92%
SED17-13	5	0.4	0.2417	0.5583	0.25	0.55	0.05701	0.1275	31.87%	58.76%
SED17-17	5	0.92	0.8258	1	0.85	1	0.03391	0.07583	8.24%	5.16%
SED17-20	5	0.62	0.4256	0.8144	0.45	0.85	0.07	0.1565	25.25%	36.08%
SED17-18	5	0.91	0.8581	0.9619	0.85	0.95	0.01871	0.04183	4.6%	6.19%
SED17-19	5	0.57	0.4867	0.6533	0.5	0.65	0.03	0.06708	11.77%	41.24%
SED17-24	5	0.89	0.7484	1	0.75	1	0.05099	0.114	12.81%	8.25%
SED17-12	5	0.83	0.6871	0.9729	0.65	0.95	0.05148	0.1151	13.87%	14.43%
SED17-01	5	0.77	0.6758	0.8642	0.7	0.85	0.03391	0.07583	9.85%	20.62%
SED17-03	5	0.96	0.9081	1	0.9	1	0.01871	0.04183	4.36%	1.03%
SED17-29	5	0.67	0.4807	0.8593	0.5	0.85	0.06819	0.1525	22.76%	30.93%
SED17-27	5	0.78	0.6123	0.9477	0.65	1	0.06042	0.1351	17.32%	19.59%

June 28/17

Eohaustorius 10-d Survival and Reburial Sediment Test — Nautilus Environmental

Reburial Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	1	1	1	1	1
SED17-08	1	1	1	1	1
SED17-06	1	1	1	1	1
SED17-09	1	1	1	1	1
SED17-13	1	1	1	1	1
SED17-17	1	1	1	1	1
SED17-20	1	0.9091	1	1	1
SED17-18	1	1	1	1	1
SED17-19	1	1	1	1	1
SED17-24	1	1	1	1	1
SED17-12	1	1	1	1	1
SED17-01	0.7857	0.9286	0.9412	0.8667	1
SED17-03	1	1	1	1	1
SED17-29	1	1	1	1	1
SED17-27	1	0.6154	0.8571	0.8667	1

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	1	1	0.95	0.9	1
SED17-08	0.95	0.9	0.95	0.95	0.95
SED17-06	1	0.95	0.9	0.9	0.95
SED17-09	0.35	0.45	0.25	0.4	0.3
SED17-13	0.25	0.5	0.4	0.3	0.55
SED17-17	0.85	0.85	1	0.9	1
SED17-20	0.85	0.55	0.7	0.45	0.55
SED17-18	0.95	0.85	0.9	0.9	0.95
SED17-19	0.5	0.5	0.6	0.65	0.6
SED17-24	0.8	0.75	0.9	1	1
SED17-12	0.95	0.8	0.85	0.65	0.9
SED17-01	0.7	0.7	0.85	0.75	0.85
SED17-03	0.95	1	0.95	1	0.9
SED17-29	0.85	0.55	0.8	0.65	0.5
SED17-27	1	0.65	0.7	0.75	0.8

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	20/20	20/20	19/20	18/20	20/20
SED17-08	19/20	18/20	19/20	19/20	19/20
SED17-06	20/20	19/20	18/20	18/20	19/20
SED17-09	7/20	9/20	5/20	8/20	6/20
SED17-13	5/20	10/20	8/20	6/20	11/20
SED17-17	17/20	17/20	20/20	18/20	20/20
SED17-20	17/20	11/20	14/20	9/20	11/20
SED17-18	19/20	17/20	18/20	18/20	19/20
SED17-19	10/20	10/20	12/20	13/20	12/20
SED17-24	16/20	15/20	18/20	20/20	20/20
SED17-12	19/20	16/20	17/20	13/20	18/20
SED17-01	14/20	14/20	17/20	15/20	17/20
SED17-03	19/20	20/20	19/20	20/20	18/20
SED17-29	17/20	11/20	16/20	13/20	10/20
SED17-27	20/20	13/20	14/20	15/20	16/20

June 28/17

CETIS Analytical Report

Report Date:	21 Jun-17 11:40 (p 1 of 3)		
Test Code:	170470 | 17-4459-1101		

Eohaustorius 10-d Survival and Reburial Sediment Test — **Nautilus Environmental**

Analysis ID:	10-8689-9857	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:39	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes
Batch ID:	20-2186-1230	**Test Type:**	Survival-Reburial	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	EC/EPS 1/RM/35	**Diluent:**	Natural seawater
Ending Date:	05 Jun-17	**Species:**	Eohaustorius estuarius	**Brine:**	
Duration:	10d 0h	**Source:**	Northwestern Aquatic Science, OR	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sed	01-7363-8469	26 May-17	26 May-17	NA	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sed	Sediment Sample	Golder	Control Sediment		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Eohaustorius 10-d Survival and Reburial Sediment Test

Nautilus Environmental

Analysis ID:	10-6689-9857	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:39	Analysis:	STP 2x2 Contingency Tables	Official Results:	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Untransformed		C > T	NA	NA	

Fisher Exact/Bonferroni-Holm Test

Sample	vs	Sample	Test Stat	P-Value	P-Type	Decision(α:5%)
Control Sed		SED17-08	0.2488	0.7465	Exact	Non-Significant Effect
Control Sed		SED17-06	0.2488	0.7465	Exact	Non-Significant Effect
Control Sed		SED17-09	0	<0.0001	Exact	Significant Effect
Control Sed		SED17-13	0	<0.0001	Exact	Significant Effect
Control Sed		SED17-17	0.1067	0.4268	Exact	Non-Significant Effect
Control Sed		SED17-20	0	<0.0001	Exact	Significant Effect
Control Sed		SED17-18	0.06688	0.3344	Exact	Non-Significant Effect
Control Sed		SED17-19	0	<0.0001	Exact	Significant Effect
Control Sed		SED17-24	0.02446	0.1468	Exact	Non-Significant Effect
Control Sed		SED17-12	0.000769	0.0054	Exact	Significant Effect
Control Sed		SED17-01	1.459E-05	0.0001	Exact	Significant Effect
Control Sed		SED17-03	0.5	0.5000	Exact	Non-Significant Effect
Control Sed		SED17-29	0	<0.0001	Exact	Significant Effect
Control Sed		SED17-27	2.912E-05	0.0002	Exact	Significant Effect

Data Summary

Sample Code		NR	R	NR + R	Prop NR	Prop R	%Effect
Control Sed	Control Sed	97	3	100	0.97	0.03	0.0%
SED17-08		94	6	100	0.94	0.06	3.09%
SED17-06		94	6	100	0.94	0.06	3.09%
SED17-09		35	65	100	0.35	0.65	63.92%
SED17-13		40	60	100	0.4	0.6	58.76%
SED17-17		92	8	100	0.92	0.08	5.15%
SED17-20		62	38	100	0.62	0.38	36.08%
SED17-18		91	9	100	0.91	0.09	6.19%
SED17-19		57	43	100	0.57	0.43	41.24%
SED17-24		89	11	100	0.89	0.11	8.25%
SED17-12		83	17	100	0.83	0.17	14.43%
SED17-01		77	23	100	0.77	0.23	20.62%
SED17-03		96	4	100	0.96	0.04	1.03%
SED17-29		67	33	100	0.67	0.33	30.93%
SED17-27		78	22	100	0.78	0.22	19.59%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	1	1	0.95	0.9	1
SED17-08	0.95	0.9	0.95	0.95	0.95
SED17-06	1	0.95	0.9	0.9	0.95
SED17-09	0.35	0.45	0.25	0.4	0.3
SED17-13	0.25	0.5	0.4	0.3	0.55
SED17-17	0.85	0.85	1	0.9	1
SED17-20	0.85	0.55	0.7	0.45	0.55
SED17-18	0.95	0.85	0.9	0.9	0.95
SED17-19	0.5	0.5	0.6	0.65	0.6
SED17-24	0.8	0.75	0.9	1	1
SED17-12	0.95	0.8	0.85	0.65	0.9
SED17-01	0.7	0.7	0.85	0.75	0.85
SED17-03	0.95	1	0.95	1	0.9
SED17-29	0.85	0.55	0.8	0.65	0.5
SED17-27	1	0.65	0.7	0.75	0.8

June 28/17

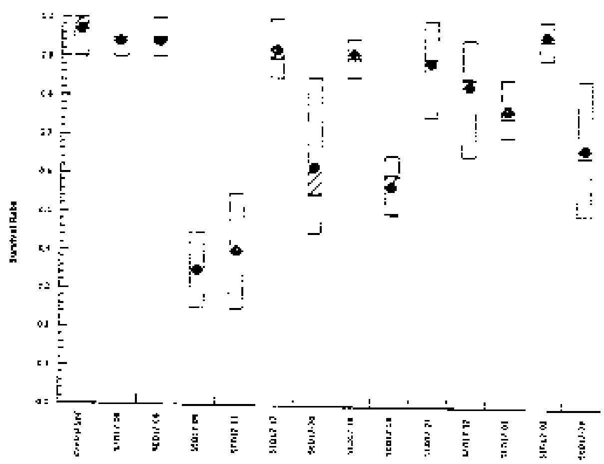
Eohaustorius 10-d Survival and Reburial Sediment Test — Nautilus Environmental

Analysis ID:	10-8689-9857	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:39	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	20/20	20/20	19/20	18/20	20/20
SED17-08	19/20	18/20	19/20	19/20	19/20
SED17-06	20/20	19/20	18/20	18/20	19/20
SED17-09	7/20	9/20	5/20	8/20	6/20
SED17-13	5/20	10/20	8/20	6/20	11/20
SED17-17	17/20	17/20	20/20	18/20	20/20
SED17-20	17/20	11/20	14/20	9/20	11/20
SED17-18	19/20	17/20	18/20	18/20	19/20
SED17-19	10/20	10/20	12/20	13/20	12/20
SED17-24	16/20	15/20	18/20	20/20	20/20
SED17-12	19/20	16/20	17/20	13/20	18/20
SED17-01	14/20	14/20	17/20	15/20	17/20
SED17-03	19/20	20/20	19/20	20/20	18/20
SED17-29	17/20	11/20	16/20	13/20	10/20
SED17-27	20/20	13/20	14/20	15/20	16/20

Graphics



June 28/17

CETIS Analytical Report

Report Date: 21 Jun-17 11:46 (p 1 of 3)
Test Code: 170470a | 02-0337-8486

Eohaustorius 10-d Survival and Reburial Sediment Test

Nautilus Environmental

Analysis ID:	11-1812-3463	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:25	Analysis:	STP 2x2 Contingency Tables	Official Results:	Yes
Batch ID:	17-4415-3617	Test Type:	Survival-Reburial	Analyst:	Jeslin Wijaya
Start Date:	26 May-17	Protocol:	EC/EPS 1/RM/35	Diluent:	Natural seawater
Ending Date:	05 Jun-17	Species:	Eohaustorius estuarius	Brine:	
Duration:	10d 0h	Source:	Northwestern Aquatic Science, OR	Age:	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Untransformed		C > T	NA	NA	

Fisher Exact/Bonferroni-Holm Test

Sample	vs	Sample	Test Stat	P-Value	P-Type	Decision(α:5%)
SED17-24		SED17-08	1	1.0000	Exact	Non-Significant Effect
SED17-24		SED17-06	1	1.0000	Exact	Non-Significant Effect
SED17-24		SED17-09	0	<0.0001	Exact	Significant Effect
SED17-24		SED17-13	0	<0.0001	Exact	Significant Effect
SED17-24		SED17-17	1	1.0000	Exact	Non-Significant Effect
SED17-24		SED17-20	6.584E-06	<0.0001	Exact	Significant Effect
SED17-24		SED17-18	1	1.0000	Exact	Non-Significant Effect
SED17-24		SED17-19	2.196E-07	<0.0001	Exact	Significant Effect
SED17-24		SED17-12	0.1541	0.9248	Exact	Non-Significant Effect
SED17-24		SED17-01	0.01865	0.1492	Exact	Non-Significant Effect
SED17-24		SED17-03	1	1.0000	Exact	Non-Significant Effect
SED17-24		SED17-29	0.0001367	0.0012	Exact	Significant Effect
SED17-24		SED17-27	0.02781	0.1946	Exact	Non-Significant Effect

June 28/17

Eohaustorius 10-d Survival and Reburial Sediment Test

Nautilus Environmental

Analysis ID:	11-1812-3463	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:25	Analysis:	STP 2x2 Contingency Tables	Official Results:	Yes

Data Summary

Sample Code		NR	R	NR + R	Prop NR	Prop R	%Effect
SED17-24	Reference Sed	89	11	100	0.89	0.11	0.0%
SED17-08		94	6	100	0.94	0.06	-5.62%
SED17-06		94	6	100	0.94	0.06	-5.62%
SED17-09		35	65	100	0.35	0.65	60.67%
SED17-13		40	60	100	0.4	0.6	55.06%
SED17-17		92	8	100	0.92	0.08	-3.37%
SED17-20		62	38	100	0.62	0.38	30.34%
SED17-18		91	9	100	0.91	0.09	-2.25%
SED17-19		57	43	100	0.57	0.43	35.96%
SED17-12		83	17	100	0.83	0.17	6.74%
SED17-01		77	23	100	0.77	0.23	13.48%
SED17-03		96	4	100	0.96	0.04	-7.87%
SED17-29		67	33	100	0.67	0.33	24.72%
SED17-27		78	22	100	0.78	0.22	12.36%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	0.8	0.75	0.9	1	1
SED17-08	0.95	0.9	0.95	0.95	0.95
SED17-06	1	0.95	0.9	0.9	0.95
SED17-09	0.35	0.45	0.25	0.4	0.3
SED17-13	0.25	0.5	0.4	0.3	0.55
SED17-17	0.85	0.85	1	0.9	1
SED17-20	0.85	0.55	0.7	0.45	0.55
SED17-18	0.95	0.85	0.9	0.9	0.95
SED17-19	0.5	0.5	0.6	0.65	0.6
SED17-12	0.95	0.8	0.85	0.65	0.9
SED17-01	0.7	0.7	0.85	0.75	0.85
SED17-03	0.95	1	0.95	1	0.9
SED17-29	0.85	0.55	0.8	0.65	0.5
SED17-27	1	0.65	0.7	0.75	0.8

Survival Rate Binomials

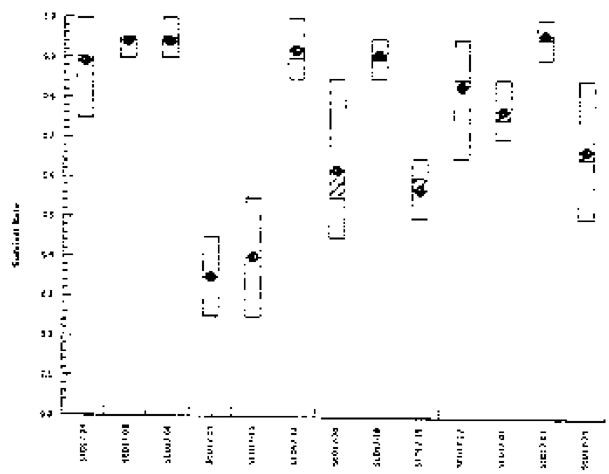
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	16/20	15/20	18/20	20/20	20/20
SED17-08	19/20	18/20	19/20	19/20	19/20
SED17-06	20/20	19/20	18/20	18/20	19/20
SED17-09	7/20	9/20	5/20	8/20	6/20
SED17-13	5/20	10/20	8/20	6/20	11/20
SED17-17	17/20	17/20	20/20	18/20	20/20
SED17-20	17/20	11/20	14/20	9/20	11/20
SED17-18	19/20	17/20	18/20	18/20	19/20
SED17-19	10/20	10/20	12/20	13/20	12/20
SED17-12	19/20	16/20	17/20	13/20	18/20
SED17-01	14/20	14/20	17/20	15/20	17/20
SED17-03	19/20	20/20	19/20	20/20	18/20
SED17-29	17/20	11/20	16/20	13/20	10/20
SED17-27	20/20	13/20	14/20	15/20	16/20

June 28/17

Echaustorius 10-d Survival and Reburial Sediment Test — **Nautilus Environmental**

Analysis ID:	11-1812-3463	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:25	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Graphics



CETIS Analytical Report

Report Date: 21 Jun-17 11:47 (p 1 of 3)
Test Code: 170470b | 03-8185-0459

Eohaustorius 10-d Survival and Reburial Sediment Test — Nautilus Environmental

Analysis ID:	02-9216-2478	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:30	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes
Batch ID:	13-2541-3912	**Test Type:**	Survival-Reburial	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	EC/EPS 1/RM/35	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Eohaustorius estuarius	**Brine:**	
Duration:	20d 0h	**Source:**	Northwestern Aquatic Science, OR	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Untransformed		C > T	NA	NA	

Fisher Exact/Bonferroni-Holm Test

Sample	vs	Sample	Test Stat	P-Value	P-Type	Decision(α:5%)
SED17-29		SED17-08	1	1.0000	Exact	Non-Significant Effect
SED17-29		SED17-06	1	1.0000	Exact	Non-Significant Effect
SED17-29		SED17-09	4.947E-06	<0.0001	Exact	Significant Effect
SED17-29		SED17-13	0.0001052	0.0013	Exact	Significant Effect
SED17-29		SED17-17	1	1.0000	Exact	Non-Significant Effect
SED17-29		SED17-20	0.2773	1.0000	Exact	Non-Significant Effect
SED17-29		SED17-18	1	1.0000	Exact	Non-Significant Effect
SED17-29		SED17-19	0.09483	1.0000	Exact	Non-Significant Effect
SED17-29		SED17-24	1	1.0000	Exact	Non-Significant Effect
SED17-29		SED17-12	1	1.0000	Exact	Non-Significant Effect
SED17-29		SED17-01	1	1.0000	Exact	Non-Significant Effect
SED17-29		SED17-03	1	1.0000	Exact	Non-Significant Effect
SED17-29		SED17-27	1	1.0000	Exact	Non-Significant Effect

Eohaustorius 10-d Survival and Reburial Sediment Test — Nautilus Environmental

Analysis ID:	02-9216-2478	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:30	Analysis:	STP 2x2 Contingency Tables	Official Results:	Yes

Data Summary

Sample Code		NR	R	NR + R	Prop NR	Prop R	%Effect
SED17-29	Reference Sed	67	33	100	0.67	0.33	0.0%
SED17-08		94	6	100	0.94	0.06	-40.3%
SED17-06		94	6	100	0.94	0.06	-40.3%
SED17-09		35	65	100	0.35	0.65	47.76%
SED17-13		40	60	100	0.4	0.6	40.3%
SED17-17		92	8	100	0.92	0.08	-37.31%
SED17-20		62	38	100	0.62	0.38	7.46%
SED17-18		91	9	100	0.91	0.09	-35.82%
SED17-19		57	43	100	0.57	0.43	14.93%
SED17-24		89	11	100	0.89	0.11	-32.84%
SED17-12		83	17	100	0.83	0.17	-23.88%
SED17-01		77	23	100	0.77	0.23	-14.93%
SED17-03		96	4	100	0.96	0.04	-43.28%
SED17-27		78	22	100	0.78	0.22	-16.42%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	0.85	0.55	0.8	0.65	0.5
SED17-08	0.95	0.9	0.95	0.95	0.95
SED17-06	1	0.95	0.9	0.9	0.95
SED17-09	0.35	0.45	0.25	0.4	0.3
SED17-13	0.25	0.5	0.4	0.3	0.55
SED17-17	0.85	0.85	1	0.9	1
SED17-20	0.85	0.55	0.7	0.45	0.55
SED17-18	0.95	0.85	0.9	0.9	0.95
SED17-19	0.5	0.5	0.6	0.65	0.6
SED17-24	0.8	0.75	0.9	1	1
SED17-12	0.95	0.8	0.85	0.65	0.9
SED17-01	0.7	0.7	0.85	0.75	0.85
SED17-03	0.95	1	0.95	1	0.9
SED17-27	1	0.65	0.7	0.75	0.8

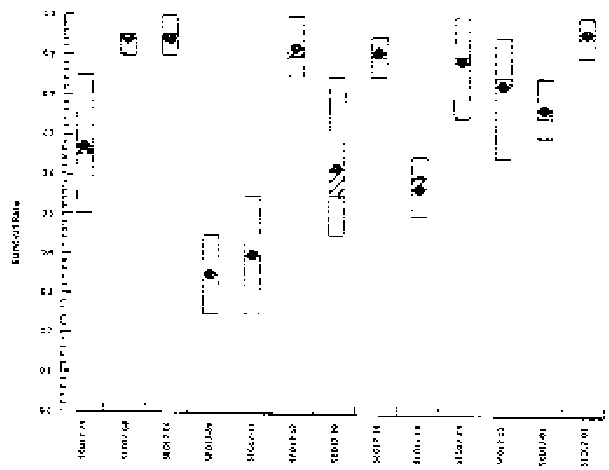
Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	17/20	11/20	16/20	13/20	10/20
SED17-08	19/20	18/20	19/20	19/20	19/20
SED17-06	20/20	19/20	18/20	18/20	19/20
SED17-09	7/20	9/20	5/20	8/20	6/20
SED17-13	5/20	10/20	8/20	6/20	11/20
SED17-17	17/20	17/20	20/20	18/20	20/20
SED17-20	17/20	11/20	14/20	9/20	11/20
SED17-18	19/20	17/20	18/20	18/20	19/20
SED17-19	10/20	10/20	12/20	13/20	12/20
SED17-24	16/20	15/20	18/20	20/20	20/20
SED17-12	19/20	16/20	17/20	13/20	18/20
SED17-01	14/20	14/20	17/20	15/20	17/20
SED17-03	19/20	20/20	19/20	20/20	18/20
SED17-27	20/20	13/20	14/20	15/20	16/20

Eohaustorius 10-d Survival and Reburial Sediment Test — **Nautilus Environmental**

Analysis ID:	02-9216-2478	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:30	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Graphics



CETIS Analytical Report

Report Date:	21 Jun-17 11:47 (p 1 of 3)		
Test Code:	170470c | 08-6646-1775		

Eohaustorius 10-d Survival and Reburial Sediment Test — **Nautilus Environmental**

Analysis ID:	19-8985-2781	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:33	Analysis:	STP 2x2 Contingency Tables	Official Results:	Yes

Batch ID:	15-0037-5148	Test Type:	Survival-Reburial	Analyst:	Jeslin Wijaya
Start Date:	26 May-17	Protocol:	EC/EPS 1/RM/35	Diluent:	Natural seawater
Ending Date:	05 Jun-17	Species:	Eohaustorius estuarius	Brine:	
Duration:	10d 0h	Source:	Northwestern Aquatic Science, OR	Age:	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-27	15-8574-6565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-27	Sediment Sample	Golder	SED17-27		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Untransformed		C > T	NA	NA	

Fisher Exact/Bonferroni-Holm Test

Sample	vs	Sample	Test Stat	P-Value	P-Type	Decision(α:5%)
SED17-27		SED17-08	1	1.0000	Exact	Non-Significant Effect
SED17-27		SED17-06	1	1.0000	Exact	Non-Significant Effect
SED17-27		SED17-09	0	<0.0001	Exact	Significant Effect
SED17-27		SED17-13	0	<0.0001	Exact	Significant Effect
SED17-27		SED17-17	1	1.0000	Exact	Non-Significant Effect
SED17-27		SED17-20	0.01011	0.1011	Exact	Non-Significant Effect
SED17-27		SED17-18	1	1.0000	Exact	Non-Significant Effect
SED17-27		SED17-19	0.0012	0.0132	Exact	Significant Effect
SED17-27		SED17-24	1	1.0000	Exact	Non-Significant Effect
SED17-27		SED17-12	1	1.0000	Exact	Non-Significant Effect
SED17-27		SED17-01	0.5	1.0000	Exact	Non-Significant Effect
SED17-27		SED17-03	1	1.0000	Exact	Non-Significant Effect
SED17-27		SED17-29	0.05642	0.5077	Exact	Non-Significant Effect

June 28/17

Eohaustorius 10-d Survival and Reburial Sediment Test — Nautilus Environmental

Analysis ID:	19-8985-2781	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:33	Analysis:	STP 2x2 Contingency Tables	Official Results:	Yes

Data Summary

Sample Code		NR	R	NR + R	Prop NR	Prop R	%Effect
SED17-27	Reference Sed	78	22	100	0.78	0.22	0.0%
SED17-08		94	6	100	0.94	0.06	-20.51%
SED17-06		94	6	100	0.94	0.06	-20.51%
SED17-09		35	65	100	0.35	0.65	55.13%
SED17-13		40	60	100	0.4	0.6	48.72%
SED17-17		92	8	100	0.92	0.08	-17.95%
SED17-20		62	38	100	0.62	0.38	20.51%
SED17-18		91	9	100	0.91	0.09	-16.67%
SED17-19		57	43	100	0.57	0.43	26.92%
SED17-24		89	11	100	0.89	0.11	-14.1%
SED17-12		83	17	100	0.83	0.17	-6.41%
SED17-01		77	23	100	0.77	0.23	1.28%
SED17-03		96	4	100	0.96	0.04	-23.08%
SED17-29		67	33	100	0.67	0.33	14.1%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	1	0.65	0.7	0.75	0.8
SED17-08	0.95	0.9	0.95	0.95	0.95
SED17-06	1	0.95	0.9	0.9	0.95
SED17-09	0.35	0.45	0.25	0.4	0.3
SED17-13	0.25	0.5	0.4	0.3	0.55
SED17-17	0.85	0.85	1	0.9	1
SED17-20	0.85	0.55	0.7	0.45	0.55
SED17-18	0.95	0.85	0.9	0.9	0.95
SED17-19	0.5	0.5	0.6	0.65	0.6
SED17-24	0.8	0.75	0.9	1	1
SED17-12	0.95	0.8	0.85	0.65	0.9
SED17-01	0.7	0.7	0.85	0.75	0.85
SED17-03	0.95	1	0.95	1	0.9
SED17-29	0.85	0.55	0.8	0.65	0.5

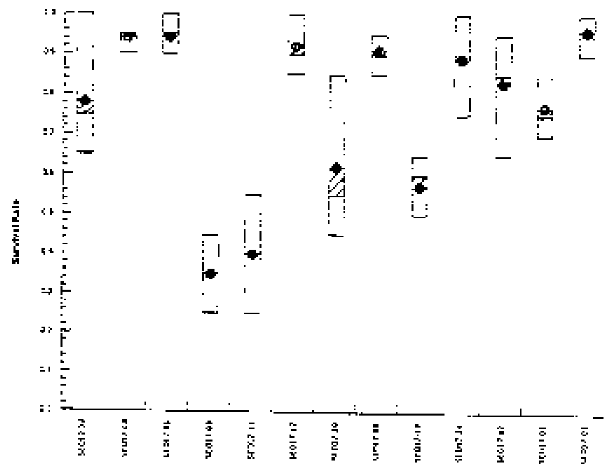
Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	20/20	13/20	14/20	15/20	16/20
SED17-08	19/20	18/20	19/20	19/20	19/20
SED17-06	20/20	19/20	18/20	18/20	19/20
SED17-09	7/20	9/20	5/20	8/20	6/20
SED17-13	5/20	10/20	8/20	6/20	11/20
SED17-17	17/20	17/20	20/20	18/20	20/20
SED17-20	17/20	11/20	14/20	9/20	11/20
SED17-18	19/20	17/20	18/20	18/20	19/20
SED17-19	10/20	10/20	12/20	13/20	12/20
SED17-24	16/20	15/20	18/20	20/20	20/20
SED17-12	19/20	16/20	17/20	13/20	18/20
SED17-01	14/20	14/20	17/20	15/20	17/20
SED17-03	19/20	20/20	19/20	20/20	18/20
SED17-29	17/20	11/20	16/20	13/20	10/20

June 28/17

Analysis ID:	19-8985-2781	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:33	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Graphics



NAUTILUS ENVIRONMENTAL
ATTN: Jeslin Wijaya
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 26-MAY-17
Report Date: 05-JUN-17 15:08 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L1932455

Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: OL-2454
Legal Site Desc:

Heather McKenzie
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932455-1	L1932455-2	L1932455-3	L1932455-4	L1932455-5
	Description	Overlying Water	Overlying Water	Overlying Water	Overlying Water	Overlying Water
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	CONTROL SEDIMENT - OVERLYING	SED 17-12 - OVERLYING	SED 17-13 - OVERLYING	SED 17-06- OVERLYING	SED 17-08- OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0282	0.377	0.120	0.773	0.747
	Sulphide as S (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932455-6	L1932455-7	L1932455-8	L1932455-9	L1932455-10
	Description	Overlying Water	Overlying Water	Overlying Water	Overlying Water	Overlying Water
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-09-OVERLYING	SED-17-17 - OVERLYING	SED 17-18-OVERLYING	SED 17-01 - OVERLYING	SED 17-03 - OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.219	0.545	0.446	0.421	1.48
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932455-11	L1932455-12	L1932455-13	L1932455-14	L1932455-15
	Description	Overlying Water	Overlying Water	Overlying Water	Overlying Water	Overlying Water
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-19 - OVERLYING	SED 17-20 - OVERLYING	SED 17-24 - OVERLYING	SED 17-27 - OVERLYING	SED 17-29 - OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.477	0.295	0.497	0.271	0.581
	Sulphide as S (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932455-16	L1932455-17	L1932455-18	L1932455-19	L1932455-20
	Description	Porewater	Porewater	Porewater	Porewater	Porewater
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	CONTROL SEDIMENT - INTERSTITIAL	SED 17-12 - INTERSTITIAL	SED 17-13 - INTERSTITIAL	SED 17-06 - INTERSTITIAL	SED 17-08 - INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	2.93	1.25	1.12	2.69	9.18
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	0.018	37.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932455-21	L1932455-22	L1932455-23	L1932455-24	L1932455-25
	Description	Porewater	Porewater	Porewater	Porewater	Porewater
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED17-09 - INTERSTITIAL	SED17-17 - INTERSTITIAL	SED17-18 - INTERSTITIAL	SED17-01 - INTERSTITIAL	SED 17-03 - INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	1.09	4.01	2.44	2.26	4.83
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932455-26	L1932455-27	L1932455-28	L1932455-29	L1932455-30
	Description	Porewater	Porewater	Porewater	Porewater	Porewater
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-19 - INTERSTITIAL	SED 17-20 - INTERSTITIAL	SED 17-24 - INTERSTITIAL	SED 17-27 - INTERSTITIAL	SED 17-29 - INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	3.43	2.04	2.42	0.885	2.74
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Sulphide as S	MS-B	L1932455-16, -17, -18, -19, -20, -21, -22, -23, -24, -25, -26, -27, -28, -29, -30

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

ALS Test Code	Matrix	Test Description	Method Reference**
S2-T-COL-VA	Water	Total Sulphide by Colorimetric	APHA 4500-S2 Sulphide

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

OL-2454

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

COC #: OL-2454

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free : 1 800 668 9878

www.alsglobal.com

Report To	
Company:	Nautilus Environmental
Contact:	Jeslin Wijaya
Address:	8664 Commerce Court Imperial Square Lake City Burnaby, BC Canada, V5A 4N7
Phone:	604-420-8773
Fax:	604-357-1361
Invoice To	☑Email ☐Mail
Company:	Nautilus Environmental
Contact:	Jeslin Wijaya
Address:	8664 Commerce Court Imperial Square Lake City Burnaby, BC Canada, V5A 4N7
Email:	jeslin@nautilusenvironmental.ca
Phone:	604-420-8773
Lab Work Order # (lab use only)	

Reporting	
Distribution:	☐Fax ☐Mail ☑Email
☐Criteria on Report (select from Guidelines below)	
Report Type:	☐Excel ☑Digital
Report Format:	
Report Email(s):	jeslin@nautilusenvironmental.ca
EDD Format:	
EDD Email(s):	
Project Info	
Job #:	
PO/AFE:	
LSD:	
Quote #:	
ALS Contact	Sampler:

Service Requested

- ⊙ Regular (Standard Turnaround Times - Business Days) - R
- ○ Priority (3 Days) - surcharge will apply - P
- ○ Priority (2 Days) - surcharge will apply - P2
- ○ Emergency (1-2 day) – surcharge will apply - E
- ○ Same Day or Weekend Emergency - surcharge will apply - E2
- ○ Specify date required - X

Analysis Requests

Please indicate below Filtered, P F/P)

L1932455-COFC

Sample #	Sample Identification (This will appear on the report)	Longitude	Latitude	Date	Time	Sample Type	Number of Containers	Ammonia (P)	Sulfide (P)	Sulfide (P)
	Control Sediment - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-12 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-13 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-06- Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-08- Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-09- Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-17 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-18- Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		

(See page 2 for further samples)

Special Instructions/Comments

The questions below must be answered for water samples (check Yes or No)

Are any sample taken from a regulated DW system? ☐Yes ☐No

If yes, please use an authorized drinking water COC

Is the water sampled intended to be potable for human consumption? ☐Yes ☐No

Guidelines

SAMPLE CONDITION (lab use only)

☐Frozen ☐Cold ☐Ambient ☐Cooling Initiated

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Jeslin Wijaya Nautilus Environmental	Date: May 26/17	Time: 15:00	Received by: PAUL	Date: MAY 26	Time: 19:00	Temperature: 18.5 °C	Verified by:	Date:	Time:	Observations: ☐Yes If Yes add SIF

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free : 1 800 668 9878

www.alsglobal.com

Sample #	Sample Identification (This will appear on the report)	Coordinates: Longitude	Coordinates: Latitude	Date	Time	Sample Type	Number of Containers	Ammonia	Sulfide	Sulfide
								P	P	P
	SED 17-01 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-03 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-19 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-20 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-24 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-27 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-29 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	Control Sediment - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-12 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R		R
	SED 17-13 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED17-06 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-08 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED17-09 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED17-17 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED17-18 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED17-01 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-03 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-19 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-20 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-24 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-27 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-29 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	

Analysis Requests — Please indicate below Filtered, Preserved or both(F, P, F/P)

L1932455-COFC

NAUTILUS ENVIRONMENTAL
ATTN: Jeslin Wijaya
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 05-JUN-17
Report Date: 13-JUN-17 17:26 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L1936736

Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: OL-2496
Legal Site Desc:

Heather McKenzie
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936736-1	L1936736-2	L1936736-3	L1936736-4	L1936736-5
	Description	Overlying water	Overlying water	Overlying water	Overlying water	Overlying water
	Sampled Date	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	CONTROL SEDIMENT - OVERLYING	SED 17-08 - OVERLYING	SED 17-06 - OVERLYING	SED 17-09 - OVERLYING	SED 17-13 - OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0213	0.478	0.762	0.983	0.726
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936736-6	L1936736-7	L1936736-8	L1936736-9	L1936736-10
	Description	Overlying water	Overlying water	Overlying water	Overlying water	Overlying water
	Sampled Date	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-17 - OVERLYING	SED 17-20 - OVERLYING	SED 17-18 - OVERLYING	SED 17-19 - OVERLYING	SED 17-24 - OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.518	1.89	0.443	6.39	6.89
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936736-11	L1936736-12	L1936736-13	L1936736-14	L1936736-15
	Description	Overlying water	Overlying water	Overlying water	Overlying water	Overlying water
	Sampled Date	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-12 - OVERLYING	SED 17-01 - OVERLYING	SED 17-03 - OVERLYING	SED 17-29 - OVERLYING	SED 17-27 - OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0588	0.368	3.41	0.949	0.613
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936736-16	L1936736-17	L1936736-18	L1936736-19	L1936736-20
	Description	Porewater	Porewater	Porewater	Porewater	Porewater
	Sampled Date	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	CONTROL SEDIMENT - INTERSTITIAL	SED 17-08 - INTERSTITIAL	SED 17-06 - INTERSTITIAL	SED 17-09 - INTERSTITIAL	SED 17-13 - INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.117	1.43	2.25	4.06	2.31
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936736-21	L1936736-22	L1936736-23	L1936736-24	L1936736-25
	Description	Porewater	Porewater	Porewater	Porewater	Porewater
	Sampled Date	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-17 - INTERSTITIAL	SED 17-20 - INTERSTITIAL	SED 17-18 - INTERSTITIAL	SED 17-19 - INTERSTITIAL	SED 17-24 - INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	2.78	5.81	4.18	13.1	3.91
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1936736-26	L1936736-27	L1936736-28	L1936736-29	L1936736-30
	Description	Porewater	Porewater	Porewater	Porewater	Porewater
	Sampled Date	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17	05-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-12 - INTERSTITIAL	SED 17-01 - INTERSTITIAL	SED 17-03 - INTERSTITIAL	SED 17-29 - INTERSTITIAL	SED 17-27 - INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	1.96	2.05	6.38	3.41	0.835
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

ALS Test Code	Matrix	Test Description	Method Reference**
S2-T-COL-VA	Water	Total Sulphide by Colorimetric	APHA 4500-S2 Sulphide

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

OL-2496

GLOSSARY OF REPORT TERMS
Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

L1936736-COFC

Chain of Custody / Analytical Request Form
Canada Toll Free : 1 800 668 9878
www.alsglobal.com

COC #: OL-2496

Report To

Company:	Nautilus Environmental
Contact:	Jeslin Wijaya
Address:	8664 Commerce Court Imperial Square Lake City Burnaby, BC Canada, V5A 4N7
Phone:	604-420-8773
Fax:	604-357-1361

Invoice To ☑Email ☐Mail

Company:	Nautilus Environmental
Contact:	Jeslin Wijaya
Address:	8664 Commerce Court Imperial Square Lake City Burnaby, BC Canada, V5A 4N7
Email:	jeslin@nautilusenvironmental.ca
Phone:	604-420-8773

Lab Work Order # (lab use only) [redacted]

Reporting

Distribution: ☐Fax ☐Mail ☑Email

☐Criteria on Report (select from Guidelines below)

Report Type: ☐Excel ☑Digital

Report Format:

Report Email(s): jeslin@nautilusenvironmental.ca

EDD Format:

EDD Email(s):

Project Info

Job #:

PO/AFE:

LSD:

Quote #:

ALS Contact:

Sampler:

Service Requested

- ⊙ Regular (Standard Turnaround Times - Business Days) - R
- ○ Priority (3 Days) - surcharge will apply - P
- ○ Priority (2 Days) - surcharge will apply - P2
- ○ Emergency (1-2 day) – surcharge will apply - E
- ○ Same Day or Weekend Emergency - surcharge will apply - E2
- ○ Specify date required - X

Analysis Requests

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This will appear on the report)	Longitude	Latitude	Date	Time	Sample Type	Number of Containers	Ammonia (P)	Sulfide (P)
[redacted]	Control Sediment - Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-08 - Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-06 - Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-09- Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-13 - Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-17 - Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-20 - Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-18- Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	

(See page 2 for further samples)

Special Instructions/Comments

The questions below must be answered for water samples (check Yes or No)

Are any sample taken from a regulated DW system? ☐Yes ☐No

If yes, please use an authorized drinking water COC

Is the water sampled intended to be potable for human consumption? ☐Yes ☐No

Guidelines

SAMPLE CONDITION (lab use only)

☐Frozen ☐Cold ☐Ambient ☐Cooling Initiated

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations:
Jeslin W. - Nautilus Environmental	Jun 5/17	16:00	Trevor	June 5	16:55	8.3 °C				☐Yes If Yes add SIF

L1936736-COFC

Chain of Custody / Analytical Request Form
Canada Toll Free : 1 800 668 9878
www.alsglobal.com

Sample #	Sample Identification (This will appear on the report)	Coordinates Longitude	Coordinates Latitude	Date	Time	Sample Type	Number of Containers	Analysis Requests: Ammonia	Analysis Requests: Sulfide
							Please indicate below Filtered, Preserved or both(F, P, F/P)	P	P
[redacted]	SED 17-19 - Overlying			Jun-20-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-24 - Overlying			Jun-05-2017	08:00 AM	Overlying Water	1	R	
[redacted]	SED 17-12 - Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-01 - Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-03 - Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-29 - Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	SED 17-27 - Overlying			Jun-05-2017	09:00 AM	Overlying Water	1	R	
[redacted]	Control Sediment - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-08 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-06 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-09 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED17-13 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-17 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-20 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-18 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-19 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-24 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-12 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-01 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-03 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-29 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]	SED 17-27 - Interstitial			Jun-05-2017	09:00 AM	Porewater	2	R	R
[redacted]									
[redacted]									
[redacted]									
[redacted]									
[redacted]									

Trevor June 5 16:55 8.3°C

Marine Polychaete Sediment Test Summary Sheet

Client: Golder Associates
Work Order No.: 170471

Start Date: 26-May-17
Set up by: JW/KJL

Sample Information:

Sample ID: Variouis - See below
Sample Date: April, 2017: 26, ~~28~~, 29, 30
May, 2017: 1, 2, 4, 5
Date Received: 15-May-17
Sample Volume: 2 x 4L per sample

Test Organism Information:

Species: *N. arenaceodentata*
Supplier: Aquatic Toxicology Support
Date received: 24-May-17
Age or size (Day 0): 0.515 mg

Cadmium Reference Toxicant Results:

Reference Toxicant ID: NA31
Stock Solution ID: 16Cd01
Date Initiated: 26-May-17

96-h LC50 (95% CL): 7.0 (5.6 - 8.7) mg/L Cd

96-h LC50 Reference Toxicant Mean and Range: 8.7 (5.6 - 13.5) mg/L Cd CV (%): 25

Test Results:

Sample ID	Survival ± SD (%)			Total Dry Weight ± SD (mg)			Average Indiv Dry Wt. ± SD (mg)			Growth Rate ± SD (mg/worm/day)		
Control Sediment	96.0	±	8.9	47.0	±	4.9	9.8	±	0.9	0.47	±	0.04
SED17-08	100.0	±	0.0	44.0	±	9.1	8.8	±	1.8	0.41	±	0.09
SED17-06	96.0	±	8.9	48.0	±	5.5	10.1	±	1.6	0.48	±	0.08
SED17-09	92.0	±	11.0	37.8	±	9.8*(a)(c)	8.1	±	1.3*(a)(c)	0.38	±	0.07*(a)(c)
SED17-13	100.0	±	0.0	45.9	±	6.2	9.2	±	1.2	0.43	±	0.06
SED17-17	96.0	±	8.9	50.5	±	11.1	10.4	±	1.7	0.50	±	0.08
SED17-20	84.0	±	16.7	38.8	±	10.7(c)	9.1	±	1.3	0.43	±	0.07
SED17-18	96.0	±	8.9	39.0	±	2.5*(a)(c)	8.2	±	1.2*(a)(c)	0.39	±	0.06*(a)(c)
SED17-19	80.0	±	28.3	32.5	±	13.7*(a)(c)	8.0	±	1.5*(a)(c)	0.37	±	0.08*(a)(c)

Reviewed by: ell

Date reviewed: July 25, 2017

Test Results:

Sample ID	Survival ± SD (%)			Total Dry Weight ± SD (mg)			Average Indiv Dry Wt. ± SD (mg)			Growth Rate ± SD (mg/worm/day)		
SED17-24	100.0	±	0.0	48.3	±	5.8	9.7	±	1.2	0.46	±	0.06
SED17-12	96.0	±	8.9	38.9	±	3.6*(a)(c)	8.2	±	1.4*(c)	0.38	±	0.07*(c)
SED17-01	96.0	±	8.9	45.5	±	4.6	9.6	±	1.4	0.45	±	0.07
SED17-03	96.0	±	8.9	42.0	±	7.6	8.8	±	1.4(c)	0.41	±	0.07(c)
SED17-29	100.0	±	0.0	42.3	±	6.7	8.5	±	1.3*(c)	0.40	±	0.07*(c)
SED17-27	96.0	±	8.9	53.4	±	13.4	11.0	±	2.0	0.52	±	0.10

(*)Asterics indicates sample(s) that are significantly different from the Control Sediment

(a) indicates sample(s) that is significantly different from reference sediment SED17-24

(b) indicates sample(s) that is significantly different from reference sediment SED17-29

(c) indicates sample(s) that is significantly different from reference sediment SED17-27

Reviewed by: ____________________ Date reviewed: July 25, 2017

20-d *N. arenaceodentata* Sediment Toxicity Test Data Sheet

Marine Sediment 20-d Water Quality

Client: Golder Associates
Work Order No.: 170471

Start Date: 26-May-17
Termination Date: 15-Jun-17
Test Organism: *N. arenaceodentata*

Temperature (°C)

Sample ID	Day 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Control Sediment	21.0	20.0	20.0	20.5	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-08	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-06	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.2	20.2	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-09	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-13	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-17	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-20	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-18	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-19	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-24	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-12	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-01	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-03	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-29	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SED17-27	21.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Technician Initials	A	A	A	JW	JW	JW	MLT	JW	A	A	JW	JW	JW	JW	JW	A	A	JW	~~20.0~~ JW	JW JW	JW

Aeration checked ?	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Technician Initials (a.m.)	A	A	A	JW	JW	JW	JW	JW	A	A	JW	JW	JW	JW	A	A	A	JW	JW	JW
Technician Initials (p.m.)	A	A	A	JW	JW	JW	JW	JW	A	A	JW	JW	JW	JW	A	A	A	JW	JW	JW

Salinity (ppt)

Sample ID	Day 0	3	6	9	12	15	18	20
Control Sediment	26	26	26	26	27	27	28	28
SED17-08	27	27	28	27	29	28	29	27
SED17-06	27	27	27	27	27	28	28	27
SED17-09	26	27	28	27	28	28	29	28
SED17-13	27	27	28	28	28	28	29	28
SED17-17	27	27	27	27	27	27	28	27
SED17-20	29	29	29	29	28	28	28	27
SED17-18	27	27	28	28	28	28	29	28
SED17-19	27	27	27	27	27	28	28	27
SED17-24	27	27	27	27	28	28	28	27
SED17-12	26	27	27	27	28	28	28	27
SED17-01	27	27	27	27	27	27	28	27
SED17-03	27	27	27	27	28	28	28	27
SED17-29	27	27	28	27	28	28	28	27
SED17-27	27	27	28	27	28	28	28	27
Technician Initials	A	JW	MLT	A	JW	A	JW	JW

Instruments: Thermometer: CER#1 DO meter: 1/2 pH meter: 1 Salinity meter: 1/2

Comments:

Reviewed by: [signature] Date Reviewed: July 21, 2017

20-d *N. arenaceodentata* Sediment Toxicity Test Data Sheet
Marine Sediment 20-d Water Quality

Client: Golder Associates
Work Order No.: 170471

Start Date: 26-May-17
Termination Date: 15-Jun-17
Test Organism: *N. arenaceodentata*

Dissolved oxygen (mg/L)

Sample ID	Day							
	0	3	6	9	12	15	18	20
Control Sediment	7.4	7.3	7.2	7.1	6.9	7.1	7.2	7.3
SED17-08	7.5	7.3	7.2	6.9	6.9	7.0	7.2	7.3
SED17-06	7.4	7.3	7.2	7.2	6.9	7.2	7.1	7.2
SED17-09	7.5	7.2	7.2	7.1	6.9	7.1	7.0	7.1
SED17-13	7.5	7.2	6.9	7.2	6.8	7.2	7.1	7.1
SED17-17	7.5	7.2	7.0	7.0	6.9	7.1	7.1	7.1
SED17-20	7.4	7.2	7.2	7.0	7.0	7.1	7.0	7.2
SED17-18	7.4	7.2	7.2	6.9	7.0	7.0	7.1	7.2
SED17-19	7.3	7.2	7.2	6.8	7.0	7.1	7.1	7.1
SED17-24	7.4	7.2	7.2	7.0	7.0	7.2	7.1	7.3
SED17-12	7.4	7.2	7.3	7.1	7.0	7.1	7.2	7.3
SED17-01	7.5	7.2	7.2	7.2	7.0	7.1	7.1	7.3
SED17-03	7.4	7.1	7.2	7.1	7.1	7.2	7.1	7.3
SED17-29	7.4	7.2	7.2	7.1	7.1	7.2	7.1	7.3
SED17-27	7.4	7.2	7.2	7.1	7.1	7.2	7.2	7.3
Technician Initials	A	JW	MLT	A	JW	A	JW	JW

pH

Sample ID	Day							
	0	3	6	9	12	15	18	20
Control Sediment	7.7	7.6	7.6	7.7	7.6	7.7	7.7	7.6
SED17-08	7.8	7.7	7.7	7.8	7.8	7.8	7.7	7.7
SED17-06	7.7	7.6	7.7	7.8	7.8	7.8	7.8	7.8
SED17-09	7.7	7.6	7.9	7.8	7.9	7.8	7.9	7.9
SED17-13	7.7	7.5	7.6	7.8	7.9	7.8	7.9	8.0
SED17-17	7.7	7.6	7.6	7.7	8.1	8.0	7.8	7.8
SED17-20	7.7	7.7	8.1	7.9	8.1	8.1	8.1	8.1
SED17-18	7.6	7.8	8.1	8.0	8.1	8.2	8.1	8.0
SED17-19	7.7	7.8	8.0	8.0	8.1	8.1	8.1	8.0
SED17-24	7.7	7.8	7.8	7.9	7.8	8.0	7.8	7.9
SED17-12	7.7	7.7	7.7	7.8	7.8	7.9	7.8	7.7
SED17-01	7.7	7.5	7.7	7.8	7.9	8.0	7.9	7.8
SED17-03	7.7	7.9	7.9	7.8	8.2	8.1	8.0	7.9
SED17-29	7.7	7.7	7.8	7.9	8.3	8.1	8.0	8.0
SED17-27	7.7	7.7	7.6	7.7	7.7	7.7	7.7	7.7
Technician Initials	✓	JW	MLT	A	JW	A	JW	JW

Instruments: Thermometer: CER #1 DO meter: 1/2 pH meter: 1 Salinity meter: 1/2

Comments:

Reviewed by: [signature] Date Reviewed: July 21, 2017

20-d *N. arenaceodentata* Sediment Toxicity Test Data Sheet

Marine Sediment 20-d Survival and Weight

Client: Golder Associates

Work Order No.: 170471

Start Date: 26-May-17

Termination Date: 15-Jun-17

Sample ID	Rep	No. alive	No. dead	No. missing	Total Recovered	Initials	Pan weight (mg)	Pan + organism (mg)	No. weighed	Initials	Day 20 Water Quality Temp (°C)	Sal (ppt)	DO (mg/L	pH	Initials
Control	36 A	5	0	0	5	JW	1010.91	1063.26	5	JW	20.0	28	7.3	7.7	JW
Sediment	37 B	5	0	0	5		985.50	1035.14	5		20.0	27	7.3	7.6	
	38 C	5	0	0	5		1011.22	1052.88	5		20.0	27	7.3	7.6	
Pan : TS Blue	39 D	4 ①	0	1	4		1025.06	1067.10	4		20.0	28	7.3	7.7	
	40 E	5 ~~4~~ JW	0	0	JW ~~4~~ 5 ②		1030.00	1079.42	5		20.0	28	7.3	7.7	
SED17-08	21 A	5	0	0	5	MLT	1024.25	1077.14	5	JW	20.0	29	7.3	7.8	JW
	22 B	5	0	0	5		1009.13	1052.12	5		20.0	27	7.2	7.7	
	23 C	5	0	0	5		1017.74	1071.00	5		20.0	28	7.1	7.7	
Pan : Ce Blue	24 D	5	0	0	5		1015.07	1053.93	5		20.0	27	6.8	7.6	
	25 E	5	0	0	5		1028.52	1060.78	5		20.0	27	7.2	7.7	
SED17-06	26 A	5	0	JW ~~5~~ 0	5	JW	1021.18	1062.70	5	JW	20.0	27	7.1	8.0	JW
	27 B	5	0	JW ~~5~~ 0	5		1011.74	1068.37	5		JW ~~26~~ 20.0	26	7.1	7.9	JW
	28 C	5	0	JW ~~5~~ 0	5		1007.62	1053.69	5		JW ~~28~~ 20.0	28	7.0	8.0	
Pan : Ce Blue	29 D	4 ①	0	1	4		1018.96	1068.05	4		JW ~~28~~ 20.0	28	7.1	8.0	
	30 E	5	0	0	5		1011.59	1058.45	5		20.0	27	7.1	7.9	
④ SED17-09	21 A	4 ③	0	1	4	MLT	1016.92	1043.44	4	JW	20.0	28	7.1	7.8	JW
	22 B	5	0	0	5		1016.23	1054.31	5		20.0	27	7.1	8.0	
	23 C	5	0	0	5		1013.65	1063.00	5		20.0	28	7.2	8.0	
Pan : Lon Red	24 D	5	0	0	5		1010.25	1055.51	5		20.0	27	7.2	8.0	
	25 E	4 ③	0	JW ~~0~~ 1	JW ~~5~~ 4		1010.19	1040.00	4		20.0	27	7.1	7.9	

Thermometer: CER # ~~7~~ 1 JW

DO meter: 1

pH meter: 1

Salinity meter: 1 21 JW

Comments: ① checked by MLT ② 1 organism was very small ③ checked by JW ④ oily sheen in dirt

10% Reweigh : TS 36 : 1063.0 (mg)

Lon 26 : 1043.1

Reviewed by: [signature]

Date Reviewed: July 21, 2017

Issued July 4, 2007; Ver. 1.0

Nautilus Environmental

20-d *N. arenaceodentata* Sediment Toxicity Test Data Sheet

Marine Sediment 20-d Survival and Weight

Client: Golder Associates

Work Order No.: 170471

Start Date: 26-May-17

Termination Date: 15-Jun-17

Sample ID	Rep	No. alive	No. dead	No. missing	Total Recovered	Initials	Pan weight (mg)	Pan + organism (mg)	No. weighed	Initials	Day 20 Water Quality Temp (°C)	Sal (ppt)	DO (mg/L	pH	Initials
SED17- 13	26 A	5	0	0	5	JW	990.13	1027.76	5	JW	20.0	28	7.2	7.9	JW
	27 B	5	0	0	5		992.95	1033.77	5		20.0	27	7.2	7.8	
	28 C	5	0	0	5		1036.03	1087.30	5		20.0	27	7.2	7.9	
Pan = tan Red	29 D	5	0	0	5		1017.60	1067.21	5		20.0	27	7.2	7.9	
	30 E	5	0	0	5		1022.82	1072.83	5		20.0	27	7.0	7.9	
SED17- 17	26 A	5	0	0	5	MLT	985.84	1037.88	5	JW	20.0	27	7.2	7.9	JW
	27 B	5	0	0	5		1012.28	1077.~~84~~ 74 JW	5		20.0	27	7.2	7.9	
	28 C	5	0	0	5		1029.80	1080.29	5		20.0	27	7.2	7.9	
Pan : Neo Purple	29 D	4 (2)	0	1	4		1021.77	1055.94	4		20.0	27	7.1	7.9	
	30 E	5	0	0	5		1012.61	1062.88	5		20.0	27	7.2	7.8	
SED17- 20	31 A	3 (1)	0	2	3	JW (1)	~~1000.57~~ JW	1011.08	3	JW	20.0	27	7.3	8.1	JW
	32 B	5	0	0	5		1008.23	1057.21	5		20.0	27	7.3	8.1	
	33 C	4 (3)	0	1	4		1011.92	1054.82	4		20.0	27	7.3	8.1	
Pan : Y Black	34 D	5	0	0	5		1023.40	1068.13	5		20.0	27	7.3	8.2	
	35 E	4 (3)	0	1	4		1017.09	1053.21	4		20.0	27	7.3	8.1	
SED17- 18	26 A	5	0	0	5	MLT	1000.56	1041.95	5	JW	20.0	27	7.3	8.1	JW
	27 B	5	0	0	5		998.25	1036.54	5		20.0	27	7.3	8.0	
	28 C	5	0	0	5		995.62	1030.81	5		20.0	27	7.3	8.0	
Pan : Y Black	29 D	5	0	0	5		999.40	1038.63	5		20.0	27	7.3	8.0	
	30 E	4 (2)	0	1	4		1008.87	1049.91	4		20.0	27	7.3	8.0	

Thermometer: CER # ~~7~~ 1 JW

DO meter: 1

pH meter: 1

Salinity meter: 1

Comments: (1) 989.56 (2) checked by ~~MLT~~ JW MLT (3) Checked by MLT 10% Reweigh : tan 26 : 1027.36 , Y 32 : 1057.90 (mg)

Reviewed by: [signature]

Date Reviewed: July 21, 2017

20-d *N. arenaceodentata* Sediment Toxicity Test Data Sheet

Marine Sediment 20-d Survival and Weight

Client: Golder Associates
Work Order No.: 170471

Start Date: 26-May-17
Termination Date: 15-Jun-17

Sample ID	Rep	No. alive	No. dead	No. missing	Total Recovered	Initials	Pan weight (mg)	Pan + organism (mg)	No. weighed	Initials	Day 20 Water Quality				Initials
											Temp (°C)	Sal (ppt)	DO (mg/L	pH	
SED17- 19	1 A	5	0	0	5	KL	1029.61	1061.22	5	JW	20.0	27	7.3	8.0	JW
	2 B	5	0	0	5		1014.51	1061.55	5		20.5	27	7.3	8.1	
	3 C	2 ②	0	3	2		1032.13	1044.81	2		20.0	27	7.3	8.1	
Pan : Blue	4 D	3	0	2	3		1020.10	1047.64	3		20.0	27	7.3	8.1	
	5 E	5	0	0	5		1028.55	1072.15	5		20.0	27	7.3	8.0	
SED17- 24	6 A	5 ~~4~~ ①	0	0	5	JW	1034.00	1074.71	5	JW	20.0	27	7.3	7.8	JW
	7 B	JW 5	0	0	5		1035.24	1081.55	5		20.0	27	7.3	7.8	
	8 C	5	0	0	5		1037.98	1093.17	5		20.0	27	7.3	7.8	
Pan : Blue	9 D	5	0	0	5		1034.87	1087.83	5		20.5	27	7.3	7.8	
	10 E	5	0	0	5		1004.40	1050.71	5		20.0	27	7.3	7.8	
SED17- 12	11 A	5	0	0	5	JW	1011.48	1052.53	5	JW	20.0	27	7.3	7.9	JW
	12 B	5	0	0	5		1036.40	1077.92	5		20.0	29	7.3	7.8	
	13 C	5	0	0	5		1007.91	1042.51	5		20.0	27	7.3	7.8	
Pan : Blue	14 D	5	0	0	5		1027.99	1063.52	5		20.0	27	7.3	7.8	
	15 E	4 ①	0	1	4		1007.24	1049.18	4		20.0	28	7.3	7.8	
SED17- 01	16 A	4 ①	0	1	4	JW	1028.87	1074.63	4	JW	20.5	28	7.3	7.9	JW
	17 B	5	0	0	5		1026.66	1074.32	5		20.0	27	7.3	7.9	
	18 C	5	0	0	5		1022.77	1074.37	5		20.0	27	7.3	7.9	
Pan : Blue	19 D	5	0	0	5		1028.77	1072.04	5		20.0	28	7.3	7.9	
	20 E	5	0	0	5		1001.08	1040.32	5		20.0	27	7.3	7.8	

Thermometer: CER # 1 DO meter: 1 pH meter: 1 Salinity meter: 1

Comments: ① Checked by KL ② Checked by JW 10% Reweigh : Blue 7 : 1081.11 ; Blue 13 : 1042.14 (mg)

Reviewed by: [signature]

Date Reviewed: July 21, 2017

20-d *N. arenaceodentata* Sediment Toxicity Test Data Sheet

Marine Sediment 20-d Survival and Weight

Client: Golder Associates

Work Order No.: 170471

Start Date: 26-May-17

Termination Date: 15-Jun-17

Sample ID	Rep	No. alive	No. dead	No. missing	Total Recovered	Initials	Pan weight (mg)	Pan + organism (mg)	No. weighed	Initials	Day 20 Water Quality Temp (°C)	Sal (ppt)	DO (mg/L	pH	Initials
SED17- 09	26 A	4 ①	0	JW ~~0~~ 1	4	KL	1026.15	1061.96	4	JW	20.0	27	7.3	7.9	JW
	27 B	5	0	0	5		1021.07	1059.05	5		20.0	27	7.3	8.0	
	28 C	5	0	0	5		996.28	1049.78	5		20.0	26	7.3	7.9	
Pan : G green	29 D	5	0	0	5		1037.72	1083.55	5		20.0	27	7.3	7.9	
	30 E	5	0	0	5		1022.68	1059.47	5		20.0	27	7.3	8.0	
SED17- 29	14 A	5	0	0	5	JW	1007.32	1042.90	5	JW	20.0	28	7.1	8.0	JW
	15 B	5	0	0	5		1003.11	1049.14	5		20.0	27	7.3	8.0	
	17 C	5	0	0	5		1007.22	1043.70	5		20.0	27	7.3	8.0	
Pan : Y Black	18 D	5	0	0	5		1030.63	1082.33	5		20.0	27	7.3	7.9	
	19 E	5	6	0	5		1011.44	1053.36	5		20.0	28	7.2	8.0	
SED17- 27	19 A	5	0	0	5	JW	991.11	1048.52	5	JW	20.0	27	7.0	7.7	JW
	20 B	5	0	0	5		1002.72	1060.95	5		20.0	26	6.9	7.6	
	21 C	4 ②	0	1	4		1015.21	1045.26	4		20.0	27	7.0	7.6	
Pan : Neo Purple	22 D	5	0	0	5		1001.01	1065.17	5		20.0	27	7.1	7.7	
	25 E	5	0	0	5		1002.72	1059.94	5		20.0	27	7.0	7.7	
~~SED17-~~ [illegible]	A														
	B														
	C														
	D														
	E														

Thermometer: CER # 1 DO meter: 1 pH meter: L Salinity meter: L

Comments: ① Checked by JW ② Checked by MLT 10% Reweigh : G 29 : 1083.24 Neo 22 : 1064.87 (mg)

Reviewed by: [signature] Date Reviewed: July 21, 2017

Nautilus Environmental
Sediment Toxicity Test - Water Quality Data For Ammonia

Client : Golder Associates

Work Order No: 140470 - 140471

Species : *E. estuarius / N. arenaceodentata*

Sample Type: Ammonia - overlying

Date Measured: 26-May-17

	Sample ID	Salinity (ppt)	pH	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)	Tech Init
	Control Sediment	29	7.6	0.0282	0.000	EC
1	SED17- 08	29	7.7	0.747	0.007	
2	SED17- 06	29	7.6	0.773	0.006	
3	SED17- 09	29	7.7	0.219	0.002	
4	SED17- 13	29	7.7	0.120	0.001	
5	SED17- 17	29	7.7	0.545	0.005	
6	SED17- 20	29	7.7	0.295	0.003	
7	SED17- 18	29	7.7	0.446	0.004	
8	SED17- 19	29	7.8	0.477	0.005	
9	SED17- 24	29	7.7	0.497	0.005	
10	SED17- 12	28	7.7	0.377	0.003	
11	SED17- 01	28	7.7	0.421	0.004	
12	SED17- 03	28	7.6	1.48	0.011	
13	SED17- 29	29	7.8	0.581	0.007	
14	SED17- 27	29	7.6	0.271	0.002	↓
15						

Comments:
1. pH and salinity values were obtained from composites of all replicates.
2. Total Ammonia measurements were done by ALS. Results are ~~were~~ enclosed in the data package.

Reviewed by: [signature]

Date Reviewed: June 28, 2017

Nautilus Environmental
Sediment Toxicity Test - Water Quality Data For Ammonia

Client : Golder Associates

Work Order No: 140470 - 140471

Species : *E. estuarius / N. arenaceodentata*

Sample Type: Ammonia - interstitial

Date Measured: 26-May-17

	Sample ID	Salinity (ppt)	pH	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)	Tech Init
	Control Sediment	29	7.3	2.93	0.011	EL
1	SED17- 08	29	7.0	9.18	0.017	
2	SED17- 06	29	7.2	2.69	0.008	
3	SED17- 09	29	7.5	1.09	0.006	
4	SED17- 13	29	7.7	1.12	0.010	
5	SED17- 17	29	7.2	4.01	0.012	
6	SED17- 20	29	7.5	2.04	0.012	
7	SED17- 18	29	7.4	2.44	0.011	
8	SED17- 19	29	7.5	3.43	0.020	
9	SED17- 24	29	7.3	2.42	0.009	
10	SED17- 12	29	7.4	1.25	0.006	
11	SED17- 01	29	7.2	2.26	0.007	
12	SED17- 03	29	7.2	4.83	0.014	
13	SED17- 29	29	7.5	2.74	0.016	
14	SED17- 27	29	7.1	0.885	0.002	
15						

Comments: 1. Total Ammonia measurements were done by ALS. Results are enclosed in the data package.

Reviewed by: [signature]

Date Reviewed: June 28, 2017

Nautilus Environmental
Sediment Toxicity Test - Water Quality Data For Ammonia

Client : Golder Associates

Species : *N. arenaceodentata*

Work Order No: 140471

Sample Type: Ammonia - overlying

Date Measured: 15-Jun-17

	Sample ID	Salinity (ppt)	pH	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)	Tech Init
	Control Sediment	27	7.8			JW
1	SED17- 08	28	7.8			
2	SED17- 06	27	8.0			
3	SED17- 09	28	8.0			
4	SED17- 13	27	8.0			
5	SED17- 17	27	8.0			
6	SED17- 20	27	8.2			
7	SED17- 18	27	8.1			
8	SED17- 19	27	8.1			
9	SED17- 24	27	7.8			
10	SED17- 12	27	7.8			
11	SED17- 01	27	7.9			
12	SED17- 03	27	8.0			
13	SED17- 29	26	7.7			
14	SED17- 27	27	8.0			
15						

Comments:

Reviewed by: [signature]

Date Reviewed: July 21, 2017

Nautilus Environmental
Sediment Toxicity Test - Water Quality Data For Ammonia

Client : Golder Associates

Work Order No: 140471

Species : *N. arenaceodentata*

Sample Type: Ammonia - Interstitial

Date Measured: 15-Jun-17

	Sample ID	Salinity (ppt)	pH	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)	Tech Init
	Control Sediment	28	7.5			[illegible]
1	SED17- 08	28	7.5			
2	SED17- 06	28	7.7			
3	SED17- 09	29	7.4			
4	SED17- 13	28	7.5			
5	SED17- 17	28	7.2			
6	SED17- 20	29	6.9			
7	SED17- 18	27	6.9			
8	SED17- 19	28	7.3			
9	SED17- 24	28	7.3			
10	SED17- 12	28	7.0			
11	SED17- 01	28	7.0			
12	SED17- 03	28	7.1			
13	SED17- 29	28	7.0			
14	SED17- 27	28	7.3			
15						

Comments:

Reviewed by: [illegible]

Date Reviewed: July 21, 2017

Neanthes 20-d Survival and Growth Sediment Test

Nautilus Environmental

Batch ID:	16-1257-1507	Test Type:	Survival-Growth	Analyst:	Jeslin Wijaya
Start Date:	26 May-17	Protocol:	PSEP (1995)	Diluent:	Natural seawater
Ending Date:	15 Jun-17	Species:	Neanthes arenaceodentata	Brine:	
Duration:	20d 0h	Source:	Aquatic Toxicology Support, WA	Age:	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sed	01-7363-8469	26 May-17	26 May-17	NA	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17.00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (6.5 °C)		
SED17-27	15-8574-8565	05 May-17 17.00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sed	Sediment Sample	Golder	Control Sediment		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Individual Growth Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sed	5	0.4655	0.4106	0.5204	0.3909	0.4997	0.01977	0.04422	9.5%	0.0%
SED17-08	5	0.4148	0.302	0.5276	0.2969	0.5069	0.04062	0.09083	21.9%	10.9%
SED17-06	5	0.4791	0.3773	0.581	0.3894	0.5879	0.03668	0.08202	17.12%	-2.93%
SED17-09	5	0.3805	0.2992	0.4617	0.3057	0.4677	0.02926	0.06543	17.2%	18.27%
SED17-13	5	0.4329	0.356	0.5099	0.3506	0.487	0.02772	0.06199	14.32%	7.0%
SED17-17	5	0.4962	0.3937	0.5987	0.4014	0.6288	0.03691	0.08254	16.63%	-6.6%
SED17-20	5	0.431	0.3497	0.5123	0.3329	0.5105	0.02928	0.06548	15.19%	7.42%
SED17-18	5	0.3851	0.3089	0.4612	0.3262	0.4673	0.02743	0.06133	15.93%	17.28%
SED17-19	5	0.3741	0.2788	0.4694	0.291	0.4447	0.03432	0.07675	20.52%	19.64%
SED17-24	5	0.4572	0.3852	0.5293	0.3813	0.5262	0.02595	0.05803	12.69%	1.78%
SED17-12	5	0.3845	0.2963	0.4727	0.3203	0.4985	0.03176	0.07101	18.47%	17.4%
SED17-01	5	0.4522	0.3651	0.5392	0.3666	0.5463	0.03135	0.07011	15.5%	2.86%
SED17-03	5	0.412	0.3282	0.4958	0.3421	0.5092	0.03018	0.06748	16.38%	11.5%
SED17-29	5	0.3977	0.314	0.4813	0.3301	0.4912	0.03012	0.06735	16.94%	14.57%
SED17-27	5	0.5234	0.3978	0.649	0.3499	0.6159	0.04523	0.1011	19.32%	-12.44%

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sed	5	9.825	8.727	10.92	8.332	10.51	0.3955	0.8844	9.0%	0.0%
SED17-08	5	8.81	6.556	11.07	6.452	10.65	0.8124	1.817	20.62%	10.32%
SED17-06	5	10.1	8.061	12.13	8.304	12.27	0.7336	1.64	16.25%	-2.78%
SED17-09	5	8.124	6.499	9.749	6.63	9.87	0.5853	1.309	16.11%	17.31%
SED17-13	5	9.174	7.634	10.71	7.526	10.25	0.5544	1.24	13.51%	6.63%
SED17-17	5	10.44	8.389	12.49	8.542	13.09	0.7383	1.651	15.81%	-6.25%
SED17-20	5	9.134	7.508	10.76	7.173	10.72	0.5857	1.31	14.34%	7.03%
SED17-18	5	8.216	6.693	9.739	7.038	10.26	0.5485	1.227	14.93%	16.37%
SED17-19	5	7.996	6.091	9.902	6.334	9.408	0.6865	1.535	19.2%	18.61%
SED17-24	5	9.659	8.218	11.1	8.142	11.04	0.5191	1.161	12.02%	1.69%
SED17-12	5	8.205	6.442	9.968	6.92	10.49	0.6351	1.42	17.31%	16.49%
SED17-01	5	9.559	7.818	11.3	7.848	11.44	0.6271	1.402	14.67%	2.71%
SED17-03	5	8.755	7.079	10.43	7.358	10.7	0.6036	1.35	15.42%	10.89%
SED17-29	5	8.468	6.796	10.14	7.116	10.34	0.6024	1.347	15.91%	13.81%
SED17-27	5	10.98	8.472	13.49	7.512	12.83	0.9046	2.023	18.42%	-11.79%

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sed	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-08	5	1	1	1	1	1	0	0	0.0%	-4.17%
SED17-06	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-09	5	0.92	0.784	1	0.8	1	0.04899	0.1095	11.91%	4.17%
SED17-13	5	1	1	1	1	1	0	0	0.0%	-4.17%
SED17-17	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-20	5	0.84	0.6322	1	0.6	1	0.07483	0.1673	19.92%	12.5%
SED17-18	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-19	5	0.8	0.4488	1	0.4	1	0.1265	0.2828	35.36%	16.67%
SED17-24	5	1	1	1	1	1	0	0	0.0%	-4.17%
SED17-12	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-01	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-03	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-29	5	1	1	1	1	1	0	0	0.0%	-4.17%
SED17-27	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Total Dry Weight Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sed	5	47.02	40.98	53.06	41.66	52.35	2.174	4.862	10.34%	0.0%
SED17-08	5	44.05	32.77	55.33	32.26	53.26	4.062	9.083	20.62%	6.32%
SED17-06	5	48.03	41.16	54.91	41.52	56.63	2.477	5.538	11.53%	-2.15%
SED17-09	5	37.8	25.7	49.91	26.52	49.35	4.36	9.75	25.79%	19.6%
SED17-13	5	45.87	38.17	53.56	37.63	51.27	2.772	6.199	13.51%	2.45%
SED17-17	5	50.49	36.7	64.27	34.17	65.46	4.964	11.1	21.99%	-7.37%
SED17-20	5	38.85	25.51	52.19	21.52	48.98	4.803	10.74	27.64%	17.38%
SED17-18	5	39.03	35.93	42.13	35.19	41.39	1.117	2.497	6.4%	17.0%
SED17-19	5	32.51	15.47	49.54	12.68	47.04	6.135	13.72	42.2%	30.87%
SED17-24	5	48.3	41.09	55.5	40.71	55.19	2.595	5.803	12.02%	-2.71%
SED17-12	5	38.93	34.51	43.34	34.6	41.94	1.59	3.556	9.13%	17.21%
SED17-01	5	45.51	39.75	51.27	39.24	51.6	2.075	4.64	10.2%	3.22%
SED17-03	5	41.98	32.6	51.37	35.81	53.5	3.38	7.559	18.0%	10.72%
SED17-29	5	42.34	33.98	50.7	35.58	51.7	3.012	6.735	15.91%	9.95%
SED17-27	5	53.41	36.81	70.01	30.05	64.16	5.979	13.37	25.03%	-13.59%

Individual Growth Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	0.4978	0.4707	0.3909	0.4997	0.4685
SED17-08	0.5032	0.4041	0.5069	0.3629	0.2969
SED17-06	0.3894	0.5405	0.4349	0.5879	0.4428
SED17-09	0.3057	0.3551	0.4677	0.4269	0.3469
SED17-13	0.3506	0.3825	0.487	0.4703	0.4743
SED17-17	0.4946	0.6288	0.4791	0.4014	0.477
SED17-20	0.3329	0.464	0.5105	0.4215	0.4257
SED17-18	0.3881	0.3572	0.3262	0.3665	0.4873
SED17-19	0.291	0.4447	0.2913	0.4333	0.4102
SED17-24	0.3813	0.4374	0.5262	0.5038	0.4373
SED17-12	0.3848	0.3895	0.3203	0.3296	0.4985
SED17-01	0.5463	0.4508	0.4902	0.407	0.3666
SED17-03	0.4219	0.3541	0.5092	0.4326	0.3421
SED17-29	0.3301	0.4346	0.339	0.4912	0.3934
SED17-27	0.5484	0.5565	0.3499	0.6159	0.5464

Mean Dry Weight-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	10.47	9.928	8.332	10.51	9.884
SED17-08	10.58	8.598	10.65	7.772	6.452
SED17-06	8.304	11.33	9.214	12.27	9.372
SED17-09	6.63	7.616	9.87	9.052	7.452
SED17-13	7.526	8.164	10.25	9.922	10
SED17-17	10.41	13.09	10.1	8.542	10.05
SED17-20	7.173	9.796	10.72	8.946	9.03
SED17-18	8.278	7.658	7.038	7.846	10.26
SED17-19	6.334	9.408	6.34	9.18	8.72
SED17-24	8.142	9.262	11.04	10.59	9.262
SED17-12	8.21	8.304	6.92	7.106	10.49
SED17-01	11.44	9.532	10.32	8.654	7.848
SED17-03	8.952	7.596	10.7	9.166	7.358
SED17-29	7.116	9.206	7.296	10.34	8.384
SED17-27	11.48	11.65	7.512	12.83	11.44

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	1	1	1	0.8	1
SED17-08	1	1	1	1	1
SED17-06	1	1	1	0.8	1
SED17-09	0.8	1	1	1	0.8
SED17-13	1	1	1	1	1
SED17-17	1	1	1	0.8	1
SED17-20	0.6	1	0.8	1	0.8
SED17-18	1	1	1	1	0.8
SED17-19	1	1	0.4	0.6	1
SED17-24	1	1	1	1	1
SED17-12	1	1	1	1	0.8
SED17-01	0.8	1	1	1	1
SED17-03	0.8	1	1	1	1
SED17-29	1	1	1	1	1
SED17-27	1	1	0.8	1	1

Total Dry Weight Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	52.35	49.64	41.66	42.04	49.42
SED17-08	52.89	42.99	53.26	38.86	32.26
SED17-06	41.52	56.63	46.07	49.09	46.86
SED17-09	26.52	38.08	49.35	45.26	29.81
SED17-13	37.63	40.82	51.27	49.61	50.01
SED17-17	52.04	65.46	50.49	34.17	50.27
SED17-20	21.52	48.98	42.9	44.73	36.12
SED17-18	41.39	38.29	35.19	39.23	41.04
SED17-19	31.67	47.04	12.68	27.54	43.6
SED17-24	40.71	46.31	55.19	52.96	46.31
SED17-12	41.05	41.52	34.6	35.53	41.94
SED17-01	45.76	47.66	51.6	43.27	39.24
SED17-03	35.81	37.98	53.5	45.83	36.79
SED17-29	35.58	46.03	36.48	51.7	41.92
SED17-27	57.41	58.23	30.05	64.16	57.22

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	5/5	5/5	5/5	4/5	5/5
SED17-08	5/5	5/5	5/5	5/5	5/5
SED17-06	5/5	5/5	5/5	4/5	5/5
SED17-09	4/5	5/5	5/5	5/5	4/5
SED17-13	5/5	5/5	5/5	5/5	5/5
SED17-17	5/5	5/5	5/5	4/5	5/5
SED17-20	3/5	5/5	4/5	5/5	4/5
SED17-18	5/5	5/5	5/5	5/5	4/5
SED17-19	5/5	5/5	2/5	3/5	5/5
SED17-24	5/5	5/5	5/5	5/5	5/5
SED17-12	5/5	5/5	5/5	5/5	4/5
SED17-01	4/5	5/5	5/5	5/5	5/5
SED17-03	4/5	5/5	5/5	5/5	5/5
SED17-29	5/5	5/5	5/5	5/5	5/5
SED17-27	5/5	5/5	4/5	5/5	5/5

CETIS Analytical Report

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	14-8838-6878	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:15	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Batch ID:	16-1257-1507	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sed	01-7363-8469	26 May-17	26 May-17	NA	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5643	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4096	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sed	Sediment Sample	Golder	Control Sediment		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Analyst: JW QA: July 21/17

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	14-8838-6878	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:15	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	

Kolmogorov-Smirnov Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Control Sed		SED17-08	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-06	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-09	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-13	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-17	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-20	0.4	NA		8	0.4365	CDF	Non-Significant Effect
		SED17-18	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-19	0.4	NA		8	0.4365	CDF	Non-Significant Effect
		SED17-24	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-12	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-01	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-03	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-29	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-27	0	NA		8	0.5000	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.2994542	0.02138958	14	1.314	0.2265	Non-Significant Effect
Error	0.9766811	0.01627802	60			
Total	1.276135		74			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1.297	2.506	0.2466	Equal Variances
Variances	Levene Equality of Variance	6.987	2.394	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.8227	0.9554	<0.0001	Non-normal Distribution

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sed	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-08	5	1	1	1	1	1	1	0	0.0%	-4.17%
SED17-06	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-09	5	0.92	0.784	1	1	0.8	1	0.04899	11.91%	4.17%
SED17-13	5	1	1	1	1	1	1	0	0.0%	-4.17%
SED17-17	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-20	5	0.84	0.6322	1	0.8	0.6	1	0.07483	19.92%	12.5%
SED17-18	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-19	5	0.8	0.4488	1	1	0.4	1	0.1265	35.36%	16.67%
SED17-24	5	1	1	1	1	1	1	0	0.0%	-4.17%
SED17-12	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-01	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-03	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-29	5	1	1	1	1	1	1	0	0.0%	-4.17%
SED17-27	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%

July 21/17

Analysis ID:	14-8838-0678	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:15	Analysis:	Nonparametric-Two Sample	Official Results:	Yes

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sed	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-08	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	-3.67%
SED17-06	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-09	5	1.25	1.088	1.412	1.345	1.107	1.345	0.05833	10.43%	3.67%
SED17-13	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	-3.67%
SED17-17	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-20	5	1.158	0.9183	1.398	1.107	0.8861	1.345	0.08639	16.68%	10.75%
SED17-18	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-19	5	1.121	0.7304	1.512	1.345	0.6847	1.345	0.1408	28.08%	13.59%
SED17-24	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	-3.67%
SED17-12	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-01	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-03	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-29	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	-3.67%
SED17-27	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	1	1	1	0.8	1
SED17-08	1	1	1	1	1
SED17-06	1	1	1	0.8	1
SED17-09	0.8	1	1	1	0.8
SED17-13	1	1	1	1	1
SED17-17	1	1	1	0.8	1
SED17-20	0.6	1	0.8	1	0.8
SED17-18	1	1	1	1	0.8
SED17-19	1	1	0.4	0.6	1
SED17-24	1	1	1	1	1
SED17-12	1	1	1	1	0.8
SED17-01	0.8	1	1	1	1
SED17-03	0.8	1	1	1	1
SED17-29	1	1	1	1	1
SED17-27	1	1	0.8	1	1

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	1.345	1.345	1.345	1.107	1.345
SED17-08	1.345	1.345	1.345	1.345	1.345
SED17-06	1.345	1.345	1.345	1.107	1.345
SED17-09	1.107	1.345	1.345	1.345	1.107
SED17-13	1.345	1.345	1.345	1.345	1.345
SED17-17	1.345	1.345	1.345	1.107	1.345
SED17-20	0.8861	1.345	1.107	1.345	1.107
SED17-18	1.345	1.345	1.345	1.345	1.107
SED17-19	1.345	1.345	0.6847	0.8861	1.345
SED17-24	1.345	1.345	1.345	1.345	1.345
SED17-12	1.345	1.345	1.345	1.345	1.107
SED17-01	1.107	1.345	1.345	1.345	1.345
SED17-03	1.107	1.345	1.345	1.345	1.345
SED17-29	1.345	1.345	1.345	1.345	1.345
SED17-27	1.345	1.345	1.107	1.345	1.345

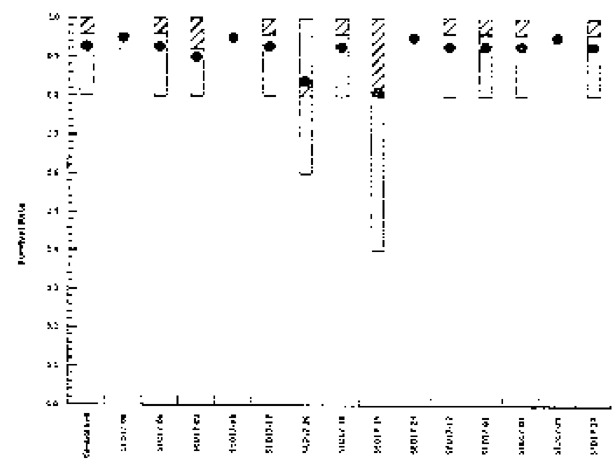
Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

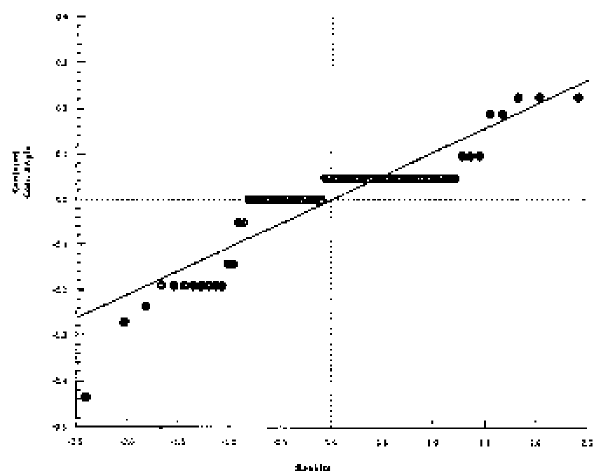
Analysis ID:	14-8838-6878	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:15	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	5/5	5/5	5/5	4/5	5/5
SED17-08	5/5	5/5	5/5	5/5	5/5
SED17-06	5/5	5/5	5/5	4/5	5/5
SED17-09	4/5	5/5	5/5	5/5	4/5
SED17-13	5/5	5/5	5/5	5/5	5/5
SED17-17	5/5	5/5	5/5	4/5	5/5
SED17-20	3/5	5/5	4/5	5/5	4/5
SED17-18	5/5	5/5	5/5	5/5	4/5
SED17-19	5/5	5/5	2/5	3/5	5/5
SED17-24	5/5	5/5	5/5	5/5	5/5
SED17-12	5/5	5/5	5/5	5/5	4/5
SED17-01	4/5	5/5	5/5	5/5	5/5
SED17-03	4/5	5/5	5/5	5/5	5/5
SED17-29	5/5	5/5	5/5	5/5	5/5
SED17-27	5/5	5/5	4/5	5/5	5/5

Graphics





CETIS Analytical Report

Report Date:	21 Jun-17 11:58 (p 1 of 3)
Test Code:	170471 | 04-9482-5635

Neanthes 20-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID:	13-9063-2482	Endpoint:	Total Dry Weight	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	Analysis:	Parametric-Two Sample	Official Results:	Yes

Batch ID:	16-1257-1507	Test Type:	Survival-Growth	Analyst:	Jeslin Wijaya
Start Date:	26 May-17	Protocol:	PSEP (1995)	Diluent:	Natural seawater
Ending Date:	15 Jun-17	Species:	Neanthes arenaceodentata	Brine:	
Duration:	20d 0h	Source:	Aquatic Toxicology Support, WA	Age:	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sed	01-7363-8469	26 May-17	26 May-17	NA	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sed	Sediment Sample	Golder	Control Sediment		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	13-9063-2482	Endpoint:	Total Dry Weight	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	Analysis:	Parametric-Two Sample	Official Results:	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	25.2%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Control Sed		SED17-08	0.6446	1.86	8.568	8	0.2686	CDF	Non-Significant Effect
		SED17-06	-0.3071	1.86	6.129	8	0.6167	CDF	Non-Significant Effect
		SED17-09	1.892	1.86	9.06	8	0.0476	CDF	Significant Effect
		SED17-13	0.3276	1.86	6.551	8	0.3758	CDF	Non-Significant Effect
		SED17-17	-0.6391	1.86	10.08	8	0.7297	CDF	Non-Significant Effect
		SED17-20	1.55	1.86	9.804	8	0.0799	CDF	Non-Significant Effect
		SED17-18	3.27	1.86	4.546	8	0.0057	CDF	Significant Effect
		SED17-19	2.23	1.86	12.1	8	0.0281	CDF	Significant Effect
		SED17-24	-0.3763	1.86	6.296	8	0.6417	CDF	Non-Significant Effect
		SED17-12	3.005	1.86	5.009	8	0.0085	CDF	Significant Effect
		SED17-01	0.5044	1.86	5.589	8	0.3138	CDF	Non-Significant Effect
		SED17-03	1.254	1.86	7.474	8	0.1226	CDF	Non-Significant Effect
		SED17-29	1.26	1.86	6.908	8	0.1216	CDF	Non-Significant Effect
		SED17-27	-1.005	1.86	11.83	8	0.8278	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2161.485	154.3918	14	2.201	0.0181	Significant Effect
Error	4209.498	70.15829	60			
Total	6370.982		74			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	21.16	29.14	0.0976	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9707	0.9554	0.0797	Normal Distribution

Total Dry Weight Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sed	5	47.02	40.98	53.06	49.42	41.66	52.35	2.174	10.34%	0.0%
SED17-08	5	44.05	32.77	55.33	42.99	32.26	53.26	4.062	20.62%	6.32%
SED17-06	5	48.03	41.16	54.91	46.86	41.52	56.63	2.477	11.53%	-2.15%
SED17-09	5	37.8	25.7	49.91	38.08	26.52	49.35	4.36	25.79%	19.6%
SED17-13	5	45.87	38.17	53.56	49.61	37.63	51.27	2.772	13.51%	2.45%
SED17-17	5	50.49	36.7	64.27	50.49	34.17	65.46	4.964	21.99%	-7.37%
SED17-20	5	38.85	25.51	52.19	42.9	21.52	48.98	4.803	27.64%	17.38%
SED17-18	5	39.03	35.93	42.13	39.23	35.19	41.39	1.117	6.4%	17.0%
SED17-19	5	32.51	15.47	49.54	31.67	12.68	47.04	6.135	42.2%	30.87%
SED17-24	5	48.3	41.09	55.5	46.31	40.71	55.19	2.595	12.02%	-2.71%
SED17-12	5	38.93	34.51	43.34	41.05	34.6	41.94	1.59	9.13%	17.21%
SED17-01	5	45.51	39.75	51.27	45.76	39.24	51.6	2.075	10.2%	3.22%
SED17-03	5	41.98	32.6	51.37	37.98	35.81	53.5	3.38	18.0%	10.72%
SED17-29	5	42.34	33.98	50.7	41.92	35.58	51.7	3.012	15.91%	9.95%
SED17-27	5	53.41	36.81	70.01	57.41	30.05	64.16	5.979	25.03%	-13.59%

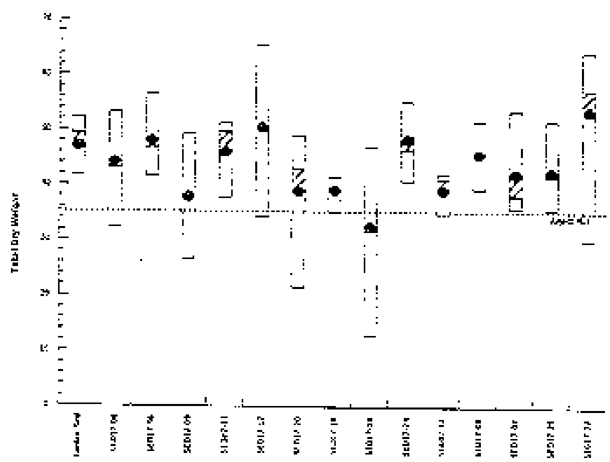
Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

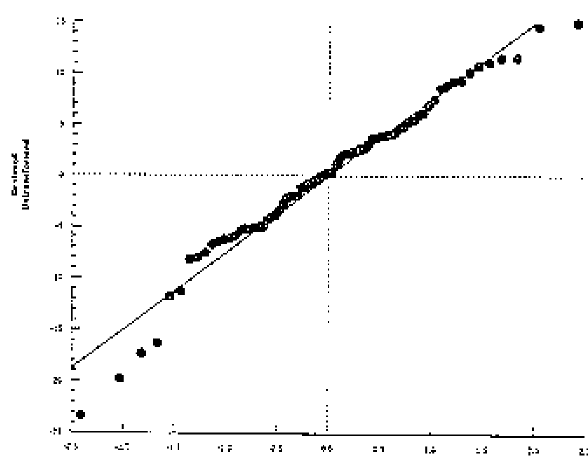
Analysis ID:	13-9063-2482	**Endpoint:**	Total Dry Weight	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Total Dry Weight Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	52.35	49.64	41.66	42.04	49.42
SED17-08	52.89	42.99	53.26	38.86	32.26
SED17-06	41.52	56.63	46.07	49.09	46.86
SED17-09	26.52	38.08	49.35	45.26	29.81
SED17-13	37.63	40.82	51.27	49.61	50.01
SED17-17	52.04	65.46	50.49	34.17	50.27
SED17-20	21.52	48.98	42.9	44.73	36.12
SED17-18	41.39	38.29	35.19	39.23	41.04
SED17-19	31.67	47.04	12.68	27.54	43.6
SED17-24	40.71	46.31	55.19	52.95	46.31
SED17-12	41.05	41.52	34.6	35.53	41.94
SED17-01	45.76	47.66	51.6	43.27	39.24
SED17-03	35.81	37.98	53.5	45.83	36.79
SED17-29	35.58	46.03	36.48	51.7	41.92
SED17-27	57.41	58.23	30.05	64.16	57.22

Graphics





CETIS Analytical Report

Report Date: 21 Jun-17 11:17 (p 1 of 3)
Test Code: 170471 | 04-9482-5635

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	01-2048-1016	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:15	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Batch ID:	16-1257-1507	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sed	01-7363-8469	26 May-17	26 May-17	NA	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sed	Sediment Sample	Golder	Control Sediment		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Analysis ID:	01-2048-1016	Endpoint:	Mean Dry Weight-mg	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:16	Analysis:	Parametric-Two Sample	Official Results:	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	18.7%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Control Sed		SED17-08	1.123	1.86	1.68	8	0.1471	CDF	Non-Significant Effect
		SED17-06	-0.3274	1.86	1.55	8	0.6241	CDF	Non-Significant Effect
		SED17-09	2.408	1.86	1.314	8	0.0213	CDF	Significant Effect
		SED17-13	0.9562	1.86	1.266	8	0.1835	CDF	Non-Significant Effect
		SED17-17	-0.7332	1.86	1.557	8	0.7578	CDF	Non-Significant Effect
		SED17-20	0.9774	1.86	1.314	8	0.1785	CDF	Non-Significant Effect
		SED17-18	2.379	1.86	1.258	8	0.0223	CDF	Significant Effect
		SED17-19	2.308	1.86	1.473	8	0.0249	CDF	Significant Effect
		SED17-24	0.2538	1.86	1.213	8	0.4030	CDF	Non-Significant Effect
		SED17-12	2.165	1.86	1.391	8	0.0312	CDF	Significant Effect
		SED17-01	0.3588	1.86	1.379	8	0.3645	CDF	Non-Significant Effect
		SED17-03	1.483	1.86	1.342	8	0.0882	CDF	Non-Significant Effect
		SED17-29	1.882	1.86	1.34	8	0.0483	CDF	Significant Effect
		SED17-27	-1.173	1.86	1.836	8	0.8628	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	58.42656	4.173326	14	1.995	0.0336	Significant Effect
Error	125.5221	2.092035	60			
Total	183.9487		74			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	3.954	29.14	0.9957	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9817	0.9554	0.3524	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sed	5	9.825	8.727	10.92	9.928	8.332	10.51	0.3955	9.0%	0.0%
SED17-08	5	8.81	6.555	11.07	8.598	6.452	10.66	0.8124	20.62%	10.32%
SED17-06	5	10.1	8.061	12.13	9.372	8.304	12.27	0.7336	16.25%	-2.78%
SED17-09	5	8.124	6.499	9.749	7.616	6.63	9.87	0.5853	16.11%	17.31%
SED17-13	5	9.174	7.634	10.71	9.922	7.526	10.25	0.5544	13.51%	6.63%
SED17-17	5	10.44	8.389	12.49	10.1	8.542	13.09	0.7383	15.81%	-6.25%
SED17-20	5	9.134	7.508	10.76	9.03	7.173	10.72	0.5857	14.34%	7.03%
SED17-18	5	8.216	6.693	9.739	7.846	7.038	10.26	0.5485	14.93%	16.37%
SED17-19	5	7.996	6.091	9.902	8.72	6.334	9.408	0.6865	19.2%	18.61%
SED17-24	5	9.659	8.218	11.1	9.262	8.142	11.04	0.5191	12.02%	1.69%
SED17-12	5	8.205	6.442	9.968	8.21	6.92	10.49	0.6351	17.31%	16.49%
SED17-01	5	9.559	7.818	11.3	9.532	7.848	11.44	0.6271	14.67%	2.71%
SED17-03	5	8.755	7.079	10.43	8.952	7.358	10.7	0.6036	15.42%	10.89%
SED17-29	5	8.468	6.796	10.14	8.384	7.116	10.34	0.6024	15.91%	13.81%
SED17-27	5	10.98	8.472	13.49	11.48	7.512	12.83	0.9046	18.42%	-11.79%

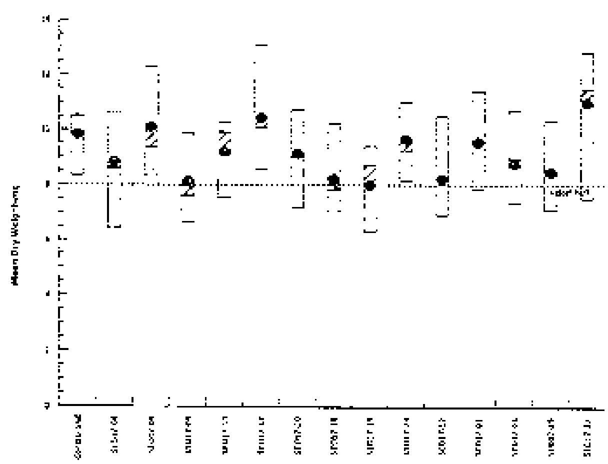
Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

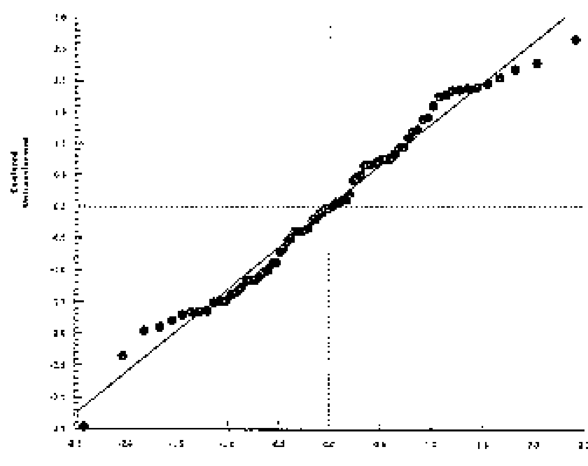
Analysis ID:	01-2048-1016	Endpoint:	Mean Dry Weight-mg	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:15	Analysis:	Parametric-Two Sample	Official Results:	Yes

Mean Dry Weight-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	10.47	9.928	8.332	10.51	9.884
SED17-08	10.58	8.598	10.65	7.772	6.452
SED17-06	8.304	11.33	9.214	12.27	9.372
SED17-09	6.63	7.616	9.87	9.052	7.452
SED17-13	7.526	8.164	10.25	9.922	10
SED17-17	10.41	13.09	10.1	8.542	10.05
SED17-20	7.173	9.796	10.72	8.946	9.03
SED17-18	8.278	7.658	7.038	7.846	10.26
SED17-19	6.334	9.408	6.34	9.18	8.72
SED17-24	8.142	9.262	11.04	10.59	9.262
SED17-12	8.21	8.304	6.92	7.106	10.49
SED17-01	11.44	9.532	10.32	8.654	7.848
SED17-03	6.952	7.596	10.7	9.166	7.358
SED17-29	7.116	9.206	7.296	10.34	8.384
SED17-27	11.48	11.65	7.512	12.83	11.44

Graphics





Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	16-4781-0451	**Endpoint:**	Individual Growth Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:15	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Batch ID:	16-1257-1507	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sed	01-7363-8469	26 May-17	26 May-17	NA	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sed	Sediment Sample	Golder	Control Sediment		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	16-4781-0451	**Endpoint:**	Individual Growth Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:15	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	19.7%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Control Sed		SED17-08	1.123	1.86	0.084	8	0.1471	CDF	Non-Significant Effect
		SED17-06	-0.3274	1.86	0.077	8	0.6241	CDF	Non-Significant Effect
		SED17-09	2.408	1.86	0.066	8	0.0213	CDF	Significant Effect
		SED17-13	0.9562	1.86	0.063	8	0.1835	CDF	Non-Significant Effect
		SED17-17	-0.7332	1.86	0.078	8	0.7578	CDF	Non-Significant Effect
		SED17-20	0.9774	1.86	0.066	8	0.1785	CDF	Non-Significant Effect
		SED17-18	2.379	1.86	0.063	8	0.0223	CDF	Significant Effect
		SED17-19	2.308	1.86	0.074	8	0.0249	CDF	Significant Effect
		SED17-24	0.2538	1.86	0.061	8	0.4030	CDF	Non-Significant Effect
		SED17-12	2.165	1.86	0.07	8	0.0312	CDF	Significant Effect
		SED17-01	0.3588	1.86	0.069	8	0.3645	CDF	Non-Significant Effect
		SED17-03	1.483	1.86	0.067	8	0.0882	CDF	Non-Significant Effect
		SED17-29	1.882	1.86	0.067	8	0.0483	CDF	Significant Effect
		SED17-27	-1.173	1.86	0.092	8	0.8628	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.1460664	0.01043331	14	1.995	0.0336	Significant Effect
Error	0.3138052	0.005230087	60			
Total	0.4598716		74			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	3.964	29.14	0.9957	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9817	0.9554	0.3524	Normal Distribution

Individual Growth Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sed	5	0.4655	0.4106	0.5204	0.4707	0.3909	0.4997	0.01977	9.5%	0.0%
SED17-08	5	0.4148	0.302	0.5276	0.4041	0.2969	0.5069	0.04062	21.9%	10.9%
SED17-06	5	0.4791	0.3773	0.581	0.4428	0.3894	0.5879	0.03668	17.12%	-2.93%
SED17-09	5	0.3805	0.2992	0.4617	0.3551	0.3057	0.4677	0.02926	17.2%	18.27%
SED17-13	5	0.4329	0.356	0.5099	0.4703	0.3506	0.487	0.02772	14.32%	7.0%
SED17-17	5	0.4962	0.3937	0.5987	0.4791	0.4014	0.6288	0.03691	16.63%	-6.6%
SED17-20	5	0.431	0.3497	0.5123	0.4257	0.3329	0.5105	0.02928	15.19%	7.42%
SED17-18	5	0.3851	0.3089	0.4612	0.3665	0.3262	0.4873	0.02743	15.93%	17.28%
SED17-19	5	0.3741	0.2788	0.4694	0.4102	0.291	0.4447	0.03432	20.52%	19.64%
SED17-24	5	0.4572	0.3852	0.5293	0.4374	0.3813	0.5262	0.02595	12.69%	1.78%
SED17-12	5	0.3845	0.2963	0.4727	0.3648	0.3203	0.4985	0.03176	18.47%	17.4%
SED17-01	5	0.4522	0.3651	0.5392	0.4508	0.3666	0.5463	0.03135	15.5%	2.86%
SED17-03	5	0.412	0.3282	0.4958	0.4219	0.3421	0.5092	0.03018	16.38%	11.5%
SED17-29	5	0.3977	0.314	0.4813	0.3934	0.3301	0.4912	0.03012	16.94%	14.57%
SED17-27	5	0.5234	0.3978	0.649	0.5484	0.3499	0.6159	0.04523	19.32%	-12.44%

Analyst: JW QA: July 24/17

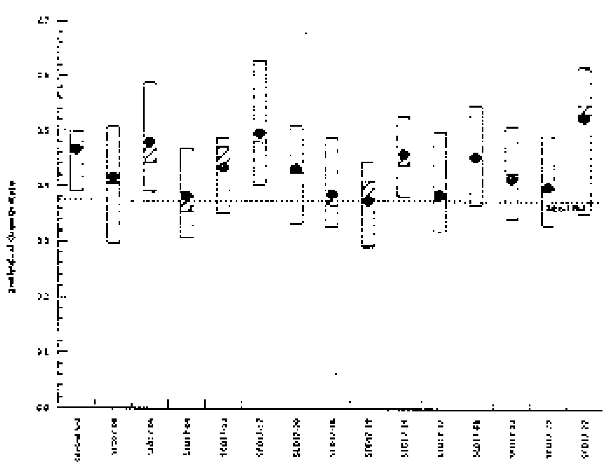
Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

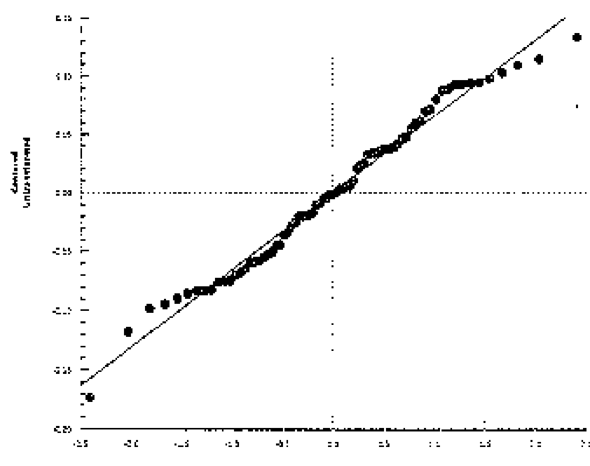
Analysis ID:	16-4781-0451	**Endpoint:**	Individual Growth Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:15	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Individual Growth Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sed	0.4978	0.4707	0.3909	0.4997	0.4685
SED17-08	0.5032	0.4041	0.5069	0.3629	0.2969
SED17-06	0.3894	0.5406	0.4349	0.5879	0.4428
SED17-09	0.3057	0.3551	0.4677	0.4269	0.3469
SED17-13	0.3506	0.3825	0.487	0.4703	0.4743
SED17-17	0.4946	0.6288	0.4791	0.4014	0.477
SED17-20	0.3329	0.464	0.5105	0.4215	0.4257
SED17-18	0.3881	0.3572	0.3262	0.3665	0.4873
SED17-19	0.291	0.4447	0.2913	0.4333	0.4102
SED17-24	0.3813	0.4374	0.5262	0.5038	0.4373
SED17-12	0.3848	0.3895	0.3203	0.3296	0.4985
SED17-01	0.5463	0.4508	0.4902	0.407	0.3666
SED17-03	0.4219	0.3541	0.5092	0.4326	0.3421
SED17-29	0.3301	0.4346	0.339	0.4912	0.3934
SED17-27	0.5484	0.5565	0.3499	0.6159	0.5464

Graphics





CETIS Summary Report

Report Date: 21 Jun-17 11:58 (p 1 of 5)
Test Code: 170471a | 03-9301-7863

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Batch ID:	04-5200-1789	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)	Golder	
SED17-08	10-1003-6381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-08	Sediment Sample.	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Individual Growth Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-24	5	0.4572	0.3852	0.5293	0.3813	0.5262	0.02595	0.05803	12.69%	0.0%
SED17-08	5	0.4148	0.302	0.5276	0.2969	0.5069	0.04062	0.09083	21.9%	9.28%
SED17-06	5	0.4791	0.3773	0.581	0.3894	0.5879	0.03668	0.08202	17.12%	-4.8%
SED17-09	5	0.3805	0.2992	0.4617	0.3057	0.4677	0.02926	0.06543	17.2%	16.79%
SED17-13	5	0.4329	0.356	0.5099	0.3506	0.487	0.02772	0.06199	14.32%	5.31%
SED17-17	5	0.4962	0.3937	0.5987	0.4014	0.6288	0.03691	0.08254	16.63%	-8.53%
SED17-20	5	0.431	0.3497	0.5123	0.3329	0.5105	0.02928	0.06548	15.19%	5.74%
SED17-18	5	0.3851	0.3089	0.4612	0.3262	0.4873	0.02743	0.06133	15.93%	15.78%
SED17-19	5	0.3741	0.2788	0.4694	0.291	0.4447	0.03432	0.07675	20.52%	18.18%
SED17-12	5	0.3845	0.2963	0.4727	0.3203	0.4985	0.03176	0.07101	18.47%	15.9%
SED17-01	5	0.4522	0.3651	0.5392	0.3666	0.5463	0.03135	0.07011	15.5%	1.1%
SED17-03	5	0.412	0.3282	0.4958	0.3421	0.5092	0.03018	0.06748	16.38%	9.89%
SED17-29	5	0.3977	0.314	0.4813	0.3301	0.4912	0.03012	0.06735	16.94%	13.02%
SED17-27	5	0.5234	0.3978	0.649	0.3499	0.6159	0.04523	0.1011	19.32%	-14.48%

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-24	5	9.659	8.218	11.1	8.142	11.04	0.5191	1.161	12.02%	0.0%
SED17-08	5	8.81	6.555	11.07	6.452	10.65	0.8124	1.817	20.62%	8.79%
SED17-06	5	10.1	8.061	12.13	8.304	12.27	0.7336	1.64	16.25%	-4.54%
SED17-09	5	8.124	6.499	9.749	6.63	9.87	0.5853	1.309	16.11%	15.89%
SED17-13	5	9.174	7.634	10.71	7.526	10.25	0.5544	1.24	13.51%	5.03%
SED17-17	5	10.44	8.389	12.49	8.542	13.09	0.7383	1.651	15.81%	-8.07%
SED17-20	5	9.134	7.508	10.76	7.173	10.72	0.5857	1.31	14.34%	5.44%
SED17-18	5	8.216	6.693	9.739	7.038	10.26	0.5485	1.227	14.93%	14.94%
SED17-19	5	7.996	6.091	9.902	6.334	9.408	0.6865	1.535	19.2%	17.21%
SED17-12	5	8.205	6.442	9.968	6.92	10.49	0.6351	1.42	17.31%	15.05%
SED17-01	5	9.559	7.818	11.3	7.848	11.44	0.6271	1.402	14.67%	1.04%
SED17-03	5	8.755	7.079	10.43	7.358	10.7	0.6036	1.35	15.42%	9.37%
SED17-29	5	8.468	6.796	10.14	7.116	10.34	0.6024	1.347	15.91%	12.33%
SED17-27	5	10.98	8.472	13.49	7.512	12.83	0.9046	2.023	18.42%	-13.71%

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-24	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-08	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-06	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-09	5	0.92	0.784	1	0.8	1	0.04899	0.1095	11.91%	8.0%
SED17-13	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-17	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-20	5	0.84	0.6322	1	0.6	1	0.07483	0.1673	19.92%	16.0%
SED17-18	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-19	5	0.8	0.4488	1	0.4	1	0.1265	0.2828	35.36%	20.0%
SED17-12	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-01	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-03	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-29	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-27	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Total Dry Weight Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-24	5	48.3	41.09	55.5	40.71	55.19	2.595	5.803	12.02%	0.0%
SED17-08	5	44.05	32.77	55.33	32.26	53.26	4.062	9.083	20.62%	8.79%
SED17-06	5	48.03	41.16	54.91	41.52	56.63	2.477	5.538	11.53%	0.54%
SED17-09	5	37.8	25.7	49.91	26.52	49.35	4.36	9.75	25.79%	21.72%
SED17-13	5	45.87	38.17	53.56	37.63	51.27	2.772	6.199	13.51%	5.03%
SED17-17	5	50.49	36.7	64.27	34.17	65.46	4.964	11.1	21.99%	-4.53%
SED17-20	5	38.85	25.51	52.19	21.52	48.98	4.803	10.74	27.64%	19.56%
SED17-18	5	39.03	35.93	42.13	35.19	41.39	1.117	2.497	6.4%	19.19%
SED17-19	5	32.51	15.47	49.54	12.68	47.04	6.135	13.72	42.2%	32.69%
SED17-12	5	38.93	34.51	43.34	34.6	41.94	1.59	3.556	9.13%	19.4%
SED17-01	5	45.51	39.75	51.27	39.24	51.6	2.075	4.64	10.2%	5.78%
SED17-03	5	41.98	32.6	51.37	35.81	53.5	3.38	7.559	18.0%	13.07%
SED17-29	5	42.34	33.98	50.7	35.58	51.7	3.012	6.735	15.91%	12.33%
SED17-27	5	53.41	36.81	70.01	30.05	64.16	5.979	13.37	25.03%	-10.6%

Individual Growth Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	0.3813	0.4374	0.5262	0.5038	0.4373
SED17-08	0.5032	0.4041	0.5069	0.3629	0.2969
SED17-06	0.3894	0.5406	0.4349	0.5879	0.4428
SED17-09	0.3057	0.3551	0.4677	0.4269	0.3469
SED17-13	0.3506	0.3825	0.487	0.4703	0.4743
SED17-17	0.4946	0.6288	0.4791	0.4014	0.477
SED17-20	0.3329	0.464	0.5105	0.4215	0.4257
SED17-18	0.3881	0.3572	0.3262	0.3665	0.4873
SED17-19	0.291	0.4447	0.2913	0.4333	0.4102
SED17-12	0.3848	0.3895	0.3203	0.3296	0.4985
SED17-01	0.5463	0.4508	0.4902	0.407	0.3666
SED17-03	0.4219	0.3541	0.5092	0.4325	0.3421
SED17-29	0.3301	0.4346	0.339	0.4912	0.3934
SED17-27	0.5484	0.5565	0.3499	0.6159	0.5464

Mean Dry Weight-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	8.142	9.262	11.04	10.59	9.262
SED17-08	10.58	8.598	10.65	7.772	6.452
SED17-06	8.304	11.33	9.214	12.27	9.372
SED17-09	6.63	7.616	9.87	9.052	7.452
SED17-13	7.526	8.164	10.25	9.922	10
SED17-17	10.41	13.09	10.1	8.542	10.05
SED17-20	7.173	9.796	10.72	8.946	9.03
SED17-18	8.278	7.658	7.038	7.846	10.26
SED17-19	6.334	9.408	6.34	9.18	8.72
SED17-12	8.21	8.304	6.92	7.106	10.49
SED17-01	11.44	9.532	10.32	8.654	7.848
SED17-03	8.952	7.596	10.7	9.166	7.358
SED17-29	7.116	9.206	7.296	10.34	8.384
SED17-27	11.48	11.65	7.512	12.83	11.44

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	1	1	1	1	1
SED17-08	1	1	1	1	1
SED17-06	1	1	1	0.8	1
SED17-09	0.8	1	1	1	0.8
SED17-13	1	1	1	1	1
SED17-17	1	1	1	0.8	1
SED17-20	0.6	1	0.8	1	0.8
SED17-18	1	1	1	1	0.8
SED17-19	1	1	0.4	0.6	1
SED17-12	1	1	1	1	0.8
SED17-01	0.8	1	1	1	1
SED17-03	0.8	1	1	1	1
SED17-29	1	1	1	1	1
SED17-27	1	1	0.8	1	1

Neanthes 20-d Survival and Growth Sediment Test

Nautilus Environmental

Total Dry Weight Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	40.71	46.31	55.19	52.96	46.31
SED17-08	52.89	42.99	53.26	38.86	32.26
SED17-06	41.52	56.63	46.07	49.09	46.86
SED17-09	26.52	38.08	49.35	45.26	29.81
SED17-13	37.63	40.82	51.27	49.61	50.01
SED17-17	52.04	65.46	50.49	34.17	50.27
SED17-20	21.52	48.98	42.9	44.73	36.12
SED17-18	41.39	38.29	35.19	39.23	41.04
SED17-19	31.67	47.04	12.68	27.54	43.6
SED17-12	41.05	41.52	34.6	35.53	41.94
SED17-01	45.76	47.66	51.6	43.27	39.24
SED17-03	35.81	37.98	53.5	45.83	36.79
SED17-29	35.58	46.03	36.48	51.7	41.92
SED17-27	57.41	58.23	30.05	64.16	57.22

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	5/5	5/5	5/5	5/5	5/5
SED17-08	5/5	5/5	5/5	5/5	5/5
SED17-06	5/5	5/5	5/5	4/5	5/5
SED17-09	4/5	5/5	5/5	5/5	4/5
SED17-13	5/5	5/5	5/5	5/5	5/5
SED17-17	5/5	5/5	5/5	4/5	5/5
SED17-20	3/5	5/5	4/5	5/5	4/5
SED17-18	5/5	5/5	5/5	5/5	4/5
SED17-19	5/5	5/5	2/5	3/5	5/5
SED17-12	5/5	5/5	5/5	5/5	4/5
SED17-01	4/5	5/5	5/5	5/5	5/5
SED17-03	4/5	5/5	5/5	5/5	5/5
SED17-29	5/5	5/5	5/5	5/5	5/5
SED17-27	5/5	5/5	4/5	5/5	5/5

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	04-2474-2326	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:48	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Batch ID:	04-5200-1769	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	

Kolmogorov-Smirnov Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-24		SED17-08	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-06	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-09	0.4	NA		8	0.4365	CDF	Non-Significant Effect
		SED17-13	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-17	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-20	0.6	NA		8	0.1786	CDF	Non-Significant Effect
		SED17-18	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-19	0.4	NA		8	0.4365	CDF	Non-Significant Effect
		SED17-12	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-01	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-03	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-29	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-27	0.2	NA		8	0.5000	CDF	Non-Significant Effect

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	04-2474-2326	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:48	Analysis:	Nonparametric-Two Sample	Official Results:	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.2987423	0.02298018	13	1.382	0.1973	Non-Significant Effect
Error	0.9313147	0.01663062	56			
Total	1.230057		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1.378	2.586	0.2102	Equal Variances
Variances	Levene Equality of Variance	7.628	2.465	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.8318	0.9526	<0.0001	Non-normal Distribution

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-24	5	1	1	1	1	1	1	0	0.0%	0.0%
SED17-08	5	1	1	1	1	1	1	0	0.0%	0.0%
SED17-06	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-09	5	0.92	0.784	1	1	0.8	1	0.04899	11.91%	8.0%
SED17-13	5	1	1	1	1	1	1	0	0.0%	0.0%
SED17-17	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-20	5	0.84	0.6322	1	0.8	0.6	1	0.07483	19.92%	16.0%
SED17-18	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-19	5	0.8	0.4488	1	1	0.4	1	0.1265	35.36%	20.0%
SED17-12	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-01	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-03	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-29	5	1	1	1	1	1	1	0	0.0%	0.0%
SED17-27	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-24	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
SED17-08	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
SED17-06	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-09	5	1.25	1.088	1.412	1.345	1.107	1.345	0.05833	10.43%	7.08%
SED17-13	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
SED17-17	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-20	5	1.158	0.9183	1.398	1.107	0.8861	1.345	0.08639	16.68%	13.91%
SED17-18	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-19	5	1.121	0.7304	1.512	1.345	0.6847	1.345	0.1408	28.08%	16.65%
SED17-12	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-01	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-03	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-29	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
SED17-27	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%

Neanthes 20-d Survival and Growth Sediment Test | Nautilus Environmental

Analysis ID:	04-2474-2326	Endpoint:	Survival Rate			CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:48	Analysis:	Nonparametric-Two Sample			Official Results:	Yes

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	1	1	1	1	1
SED17-08	1	1	1	1	1
SED17-06	1	1	1	0.8	1
SED17-09	0.8	1	1	1	0.8
SED17-13	1	1	1	1	1
SED17-17	1	1	1	0.8	1
SED17-20	0.6	1	0.8	1	0.8
SED17-18	1	1	1	1	0.8
SED17-19	1	1	0.4	0.6	1
SED17-12	1	1	1	1	0.8
SED17-01	0.8	1	1	1	1
SED17-03	0.8	1	1	1	1
SED17-29	1	1	1	1	1
SED17-27	1	1	0.8	1	1

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	1.345	1.345	1.345	1.345	1.345
SED17-08	1.345	1.345	1.345	1.345	1.345
SED17-06	1.345	1.345	1.345	1.107	1.345
SED17-09	1.107	1.345	1.345	1.345	1.107
SED17-13	1.345	1.345	1.345	1.345	1.345
SED17-17	1.345	1.345	1.345	1.107	1.345
SED17-20	0.8861	1.345	1.107	1.345	1.107
SED17-18	1.345	1.345	1.345	1.345	1.107
SED17-19	1.345	1.345	0.6847	0.8861	1.345
SED17-12	1.345	1.345	1.345	1.345	1.107
SED17-01	1.107	1.345	1.345	1.345	1.345
SED17-03	1.107	1.345	1.345	1.345	1.345
SED17-29	1.345	1.345	1.345	1.345	1.345
SED17-27	1.345	1.345	1.107	1.345	1.345

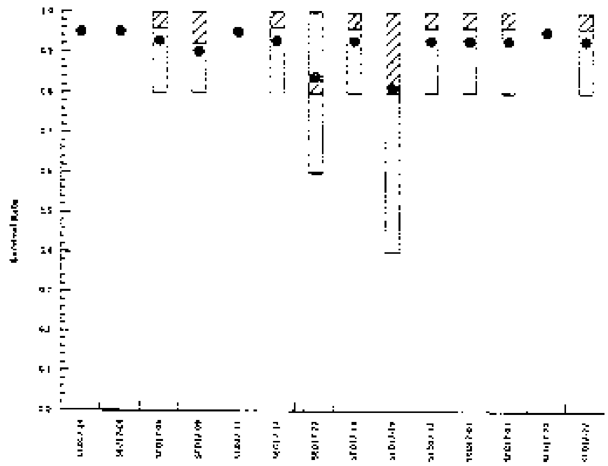
Survival Rate Binomials

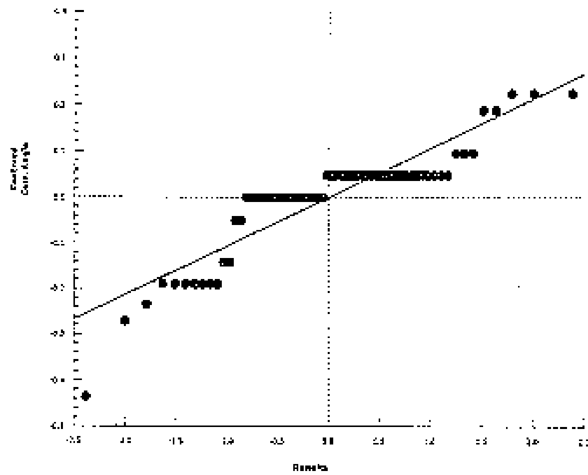
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	5/5	5/5	5/5	5/5	5/5
SED17-08	5/5	5/5	5/5	5/5	5/5
SED17-06	5/5	5/5	5/5	4/5	5/5
SED17-09	4/5	5/5	5/5	5/5	4/5
SED17-13	5/5	5/5	5/5	5/5	5/5
SED17-17	5/5	5/5	5/5	4/5	5/5
SED17-20	3/5	5/5	4/5	5/5	4/5
SED17-18	5/5	5/5	5/5	5/5	4/5
SED17-19	5/5	5/5	2/5	3/5	5/5
SED17-12	5/5	5/5	5/5	5/5	4/5
SED17-01	4/5	5/5	5/5	5/5	5/5
SED17-03	4/5	5/5	5/5	5/5	5/5
SED17-29	5/5	5/5	5/5	5/5	5/5
SED17-27	5/5	5/5	4/5	5/5	5/5

Neanthes 20-d Survival and Growth Sediment Test | Nautilus Environmental

Analysis ID:	04-2474-2326	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:48	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Report Date: 21 Jun-17 11:59 (p 1 of 3)
Test Code: 170471a | 03-9301-7863

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	18-6485-5789	**Endpoint:**	Total Dry Weight	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Batch ID:	04-5200-1789	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	25.1%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-24		SED17-08	0.8804	1.86	8.964	8	0.2022	CDF	Non-Significant Effect
		SED17-06	0.07304	1.86	6.671	8	0.4718	CDF	Non-Significant Effect
		SED17-09	2.068	1.86	9.436	8	0.0362	CDF	Significant Effect
		SED17-13	0.6394	1.86	7.061	8	0.2702	CDF	Non-Significant Effect
		SED17-17	-0.3909	1.86	10.42	8	0.6470	CDF	Non-Significant Effect
		SED17-20	1.73	1.86	10.15	8	0.0609	CDF	Non-Significant Effect
		SED17-18	3.28	1.86	5.254	8	0.0056	CDF	Significant Effect
		SED17-19	2.37	1.86	12.39	8	0.0226	CDF	Significant Effect
		SED17-12	3.078	1.86	5.66	8	0.0076	CDF	Significant Effect
		SED17-01	0.8397	1.86	6.179	8	0.2127	CDF	Non-Significant Effect
		SED17-03	1.482	1.86	7.925	8	0.0884	CDF	Non-Significant Effect
		SED17-29	1.498	1.86	7.393	8	0.0863	CDF	Non-Significant Effect
		SED17-27	-0.7852	1.86	12.12	8	0.7725	CDF	Non-Significant Effect

Analysis ID:	18-6485-5789	Endpoint:	Total Dry Weight	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	Analysis:	Parametric-Two Sample	Official Results:	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2099.04	161.4646	13	2.197	0.0216	Significant Effect
Error	4114.933	73.48094	56			
Total	6213.974		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	19.54	27.69	0.1074	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9713	0.9526	0.1076	Normal Distribution

Total Dry Weight Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-24	5	48.3	41.09	55.5	46.31	40.71	55.19	2.595	12.02%	0.0%
SED17-08	5	44.05	32.77	55.33	42.99	32.26	53.26	4.062	20.62%	8.79%
SED17-06	5	48.03	41.16	54.91	46.86	41.52	56.63	2.477	11.53%	0.54%
SED17-09	5	37.8	25.7	49.91	38.08	26.52	49.35	4.36	25.79%	21.72%
SED17-13	5	45.87	38.17	53.56	49.61	37.63	51.27	2.772	13.51%	5.03%
SED17-17	5	50.49	36.7	64.27	50.49	34.17	65.46	4.964	21.99%	-4.53%
SED17-20	5	38.85	25.51	52.19	42.9	21.52	48.98	4.803	27.64%	19.56%
SED17-18	5	39.03	35.93	42.13	39.23	35.19	41.39	1.117	6.4%	19.19%
SED17-19	5	32.51	15.47	49.54	31.67	12.68	47.04	6.135	42.2%	32.69%
SED17-12	5	38.93	34.51	43.34	41.05	34.6	41.94	1.59	9.13%	19.4%
SED17-01	5	45.51	39.75	51.27	45.76	39.24	51.6	2.075	10.2%	5.78%
SED17-03	5	41.98	32.6	51.37	37.98	35.81	53.5	3.38	18.0%	13.07%
SED17-29	5	42.34	33.98	50.7	41.92	35.58	51.7	3.012	15.91%	12.33%
SED17-27	5	53.41	36.81	70.01	57.41	30.05	64.16	5.979	25.03%	-10.6%

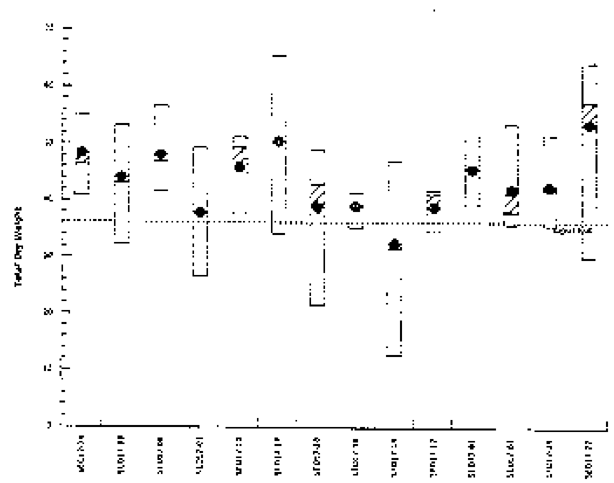
Total Dry Weight Detail

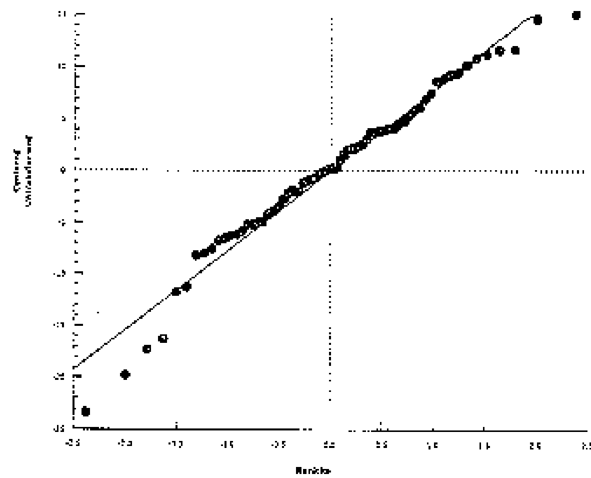
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	40.71	46.31	55.19	52.96	46.31
SED17-08	52.89	42.99	53.26	38.86	32.26
SED17-06	41.52	56.63	46.07	49.09	46.86
SED17-09	26.52	38.08	49.35	45.26	29.81
SED17-13	37.63	40.82	51.27	49.61	50.01
SED17-17	52.04	65.46	50.49	34.17	50.27
SED17-20	21.52	48.98	42.9	44.73	36.12
SED17-18	41.39	38.29	35.19	39.23	41.04
SED17-19	31.67	47.04	12.68	27.54	43.6
SED17-12	41.05	41.52	34.6	35.53	41.94
SED17-01	45.76	47.66	51.6	43.27	39.24
SED17-03	35.81	37.98	53.5	45.83	36.79
SED17-29	35.58	46.03	36.48	51.7	41.92
SED17-27	57.41	58.23	30.05	64.16	57.22

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	18-6485-5789	Endpoint:	Total Dry Weight	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	Analysis:	Parametric-Two Sample	Official Results:	Yes

Graphics





Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	17-5782-2073	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:49	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes
Batch ID:	04-5200-1789	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-6565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	20.1%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-24		SED17-08	0.8804	1.86	1.793	8	0.2022	CDF	Non-Significant Effect
		SED17-06	-0.4879	1.86	1.671	8	0.6807	CDF	Non-Significant Effect
		SED17-09	1.962	1.86	1.455	8	0.0427	CDF	Significant Effect
		SED17-13	0.6394	1.86	1.412	8	0.2702	CDF	Non-Significant Effect
		SED17-17	-0.8639	1.86	1.678	8	0.7936	CDF	Non-Significant Effect
		SED17-20	0.671	1.86	1.455	8	0.2605	CDF	Non-Significant Effect
		SED17-18	1.911	1.86	1.404	8	0.0462	CDF	Significant Effect
		SED17-19	1.932	1.86	1.6	8	0.0447	CDF	Significant Effect
		SED17-12	1.773	1.86	1.525	8	0.0571	CDF	Non-Significant Effect
		SED17-01	0.1233	1.86	1.514	8	0.4524	CDF	Non-Significant Effect
		SED17-03	1.136	1.86	1.48	8	0.1443	CDF	Non-Significant Effect
		SED17-29	1.498	1.86	1.479	8	0.0863	CDF	Non-Significant Effect
		SED17-27	-1.27	1.86	1.939	8	0.8800	CDF	Non-Significant Effect

Neanthes 20-d Survival and Growth Sediment Test | Nautilus Environmental

Analysis ID:	17-5782-2073	Endpoint:	Mean Dry Weight-mg	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:49	Analysis:	Parametric-Two Sample	Official Results:	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	56.08031	4.31387	13	1.974	0.0406	Significant Effect
Error	122.3938	2.185603	56			
Total	178.4741		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	2.599	27.69	0.9990	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9792	0.9526	0.2955	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-24	5	9.659	8.218	11.1	9.262	8.142	11.04	0.5191	12.02%	0.0%
SED17-08	5	8.81	6.555	11.07	8.598	6.452	10.65	0.8124	20.62%	8.79%
SED17-06	5	10.1	8.061	12.13	9.372	8.304	12.27	0.7336	16.25%	-4.54%
SED17-09	5	8.124	6.499	9.749	7.616	6.63	9.87	0.5853	16.11%	15.89%
SED17-13	5	9.174	7.634	10.71	9.922	7.526	10.25	0.5544	13.51%	5.03%
SED17-17	5	10.44	8.389	12.49	10.1	8.542	13.09	0.7383	15.81%	-8.07%
SED17-20	5	9.134	7.508	10.76	9.03	7.173	10.72	0.5857	14.34%	5.44%
SED17-18	5	8.216	6.693	9.739	7.846	7.038	10.26	0.5485	14.93%	14.94%
SED17-19	5	7.996	6.091	9.902	8.72	6.334	9.408	0.6865	19.2%	17.21%
SED17-12	5	8.205	6.442	9.968	8.21	6.92	10.49	0.6351	17.31%	15.05%
SED17-01	5	9.559	7.818	11.3	9.532	7.848	11.44	0.6271	14.67%	1.04%
SED17-03	5	8.755	7.079	10.43	8.952	7.358	10.7	0.6036	15.42%	9.37%
SED17-29	5	8.468	6.796	10.14	8.384	7.116	10.34	0.6024	15.91%	12.33%
SED17-27	5	10.98	8.472	13.49	11.48	7.512	12.83	0.9046	18.42%	-13.71%

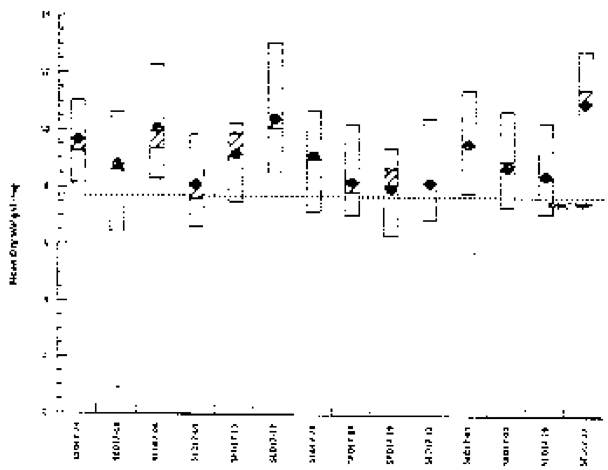
Mean Dry Weight-mg Detail

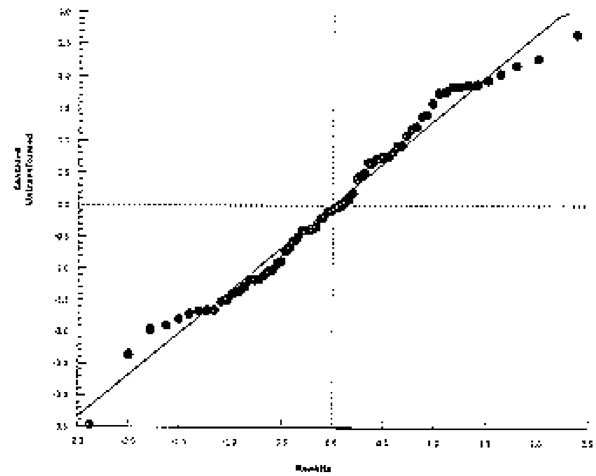
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	8.142	9.262	11.04	10.59	9.262
SED17-08	10.58	8.598	10.65	7.772	6.452
SED17-06	8.304	11.33	9.214	12.27	9.372
SED17-09	6.63	7.616	9.87	9.052	7.452
SED17-13	7.526	8.164	10.25	9.922	10
SED17-17	10.41	13.09	10.1	8.542	10.05
SED17-20	7.173	9.796	10.72	8.946	9.03
SED17-18	8.278	7.658	7.038	7.846	10.26
SED17-19	6.334	9.408	6.34	9.18	8.72
SED17-12	8.21	8.304	6.92	7.106	10.49
SED17-01	11.44	9.532	10.32	8.654	7.848
SED17-03	8.952	7.596	10.7	9.166	7.358
SED17-29	7.116	9.206	7.296	10.34	8.384
SED17-27	11.48	11.65	7.512	12.83	11.44

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	17-5782-2073	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:49	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Report Date:	21 Jun-17 11:23 (p 1 of 3)	Test Code:	170471a | 03-9301-7863

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	19-1681-4692	Endpoint:	Individual Growth Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:49	Analysis:	Parametric-Two Sample	Official Results:	Yes

Batch ID:	04-5200-1789	Test Type:	Survival-Growth	Analyst:	Jeslin Wijaya
Start Date:	26 May-17	Protocol:	PSEP (1995)	Diluent:	Natural seawater
Ending Date:	15 Jun-17	Species:	Neanthes arenaceodentata	Brine:	
Duration:	20d 0h	Source:	Aquatic Toxicology Support, WA	Age:	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-6235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5643	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	21.2%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-24		SED17-08	0.8804	1.86	0.09	8	0.2022	CDF	Non-Significant Effect
		SED17-06	-0.4879	1.86	0.084	8	0.6807	CDF	Non-Significant Effect
		SED17-09	1.962	1.86	0.073	8	0.0427	CDF	Significant Effect
		SED17-13	0.6394	1.86	0.071	8	0.2702	CDF	Non-Significant Effect
		SED17-17	-0.8639	1.86	0.084	8	0.7936	CDF	Non-Significant Effect
		SED17-20	0.671	1.86	0.073	8	0.2605	CDF	Non-Significant Effect
		SED17-18	1.911	1.86	0.070	8	0.0462	CDF	Significant Effect
		SED17-19	1.932	1.86	0.080	8	0.0447	CDF	Significant Effect
		SED17-12	1.773	1.86	0.076	8	0.0571	CDF	Non-Significant Effect
		SED17-01	0.1233	1.86	0.076	8	0.4524	CDF	Non-Significant Effect
		SED17-03	1.136	1.86	0.074	8	0.1443	CDF	Non-Significant Effect
		SED17-29	1.498	1.86	0.074	8	0.0863	CDF	Non-Significant Effect
		SED17-27	-1.27	1.86	0.097	8	0.8800	CDF	Non-Significant Effect

Analysis ID:	19-1681-4692	Endpoint:	Individual Growth Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:49	Analysis:	Parametric-Two Sample	Official Results:	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.1402008	0.01078467	13	1.974	0.0406	Significant Effect
Error	0.3059843	0.005464006	56			
Total	0.4461851		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	2.599	27.69	0.9990	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9792	0.9526	0.2955	Normal Distribution

Individual Growth Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-24	5	0.4572	0.3852	0.5293	0.4374	0.3813	0.5262	0.02595	12.69%	0.0%
SED17-08	5	0.4148	0.302	0.5276	0.4041	0.2969	0.5069	0.04062	21.9%	9.28%
SED17-06	5	0.4791	0.3773	0.581	0.4428	0.3894	0.5879	0.03668	17.12%	-4.8%
SED17-09	5	0.3805	0.2992	0.4617	0.3551	0.3057	0.4677	0.02926	17.2%	16.79%
SED17-13	5	0.4329	0.356	0.5099	0.4703	0.3506	0.487	0.02772	14.32%	5.31%
SED17-17	5	0.4962	0.3937	0.5987	0.4791	0.4014	0.6288	0.03691	16.63%	-8.53%
SED17-20	5	0.431	0.3497	0.5123	0.4257	0.3329	0.5105	0.02928	15.19%	5.74%
SED17-18	5	0.3851	0.3089	0.4612	0.3665	0.3262	0.4873	0.02743	15.93%	15.78%
SED17-19	5	0.3741	0.2788	0.4694	0.4102	0.291	0.4447	0.03432	20.52%	18.18%
SED17-12	5	0.3845	0.2963	0.4727	0.3848	0.3203	0.4985	0.03176	18.47%	15.9%
SED17-01	5	0.4522	0.3651	0.5392	0.4508	0.3666	0.5463	0.03135	15.5%	1.1%
SED17-03	5	0.412	0.3282	0.4958	0.4219	0.3421	0.5092	0.03018	16.38%	9.89%
SED17-29	5	0.3977	0.314	0.4813	0.3934	0.3301	0.4912	0.03012	16.94%	13.02%
SED17-27	5	0.5234	0.3978	0.649	0.5484	0.3499	0.6159	0.04523	19.32%	-14.48%

Individual Growth Rate Detail

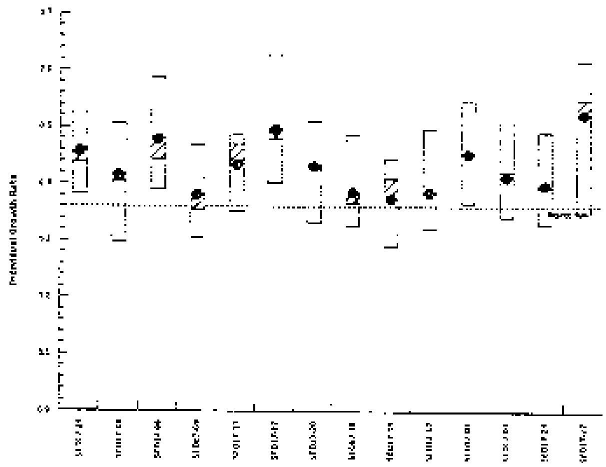
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-24	0.3813	0.4374	0.5262	0.5038	0.4373
SED17-08	0.5032	0.4041	0.5069	0.3629	0.2969
SED17-06	0.3894	0.5406	0.4349	0.5879	0.4428
SED17-09	0.3057	0.3551	0.4677	0.4269	0.3469
SED17-13	0.3506	0.3825	0.487	0.4703	0.4743
SED17-17	0.4946	0.6288	0.4791	0.4014	0.477
SED17-20	0.3329	0.464	0.5105	0.4215	0.4257
SED17-18	0.3681	0.3572	0.3262	0.3665	0.4873
SED17-19	0.291	0.4447	0.2913	0.4333	0.4102
SED17-12	0.3848	0.3895	0.3203	0.3296	0.4985
SED17-01	0.5463	0.4508	0.4902	0.407	0.3666
SED17-03	0.4219	0.3541	0.5092	0.4326	0.3421
SED17-29	0.3301	0.4346	0.339	0.4912	0.3934
SED17-27	0.5484	0.5565	0.3499	0.6159	0.5464

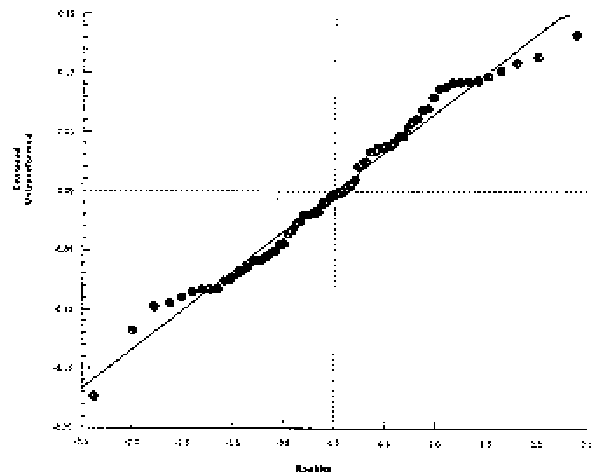
Analyst: JW QA: July 24/17

Neanthes 20-d Survival and Growth Sediment Test | **Nautilus Environmental**

Analysis ID: 19-1681-4692	**Endpoint:**	Individual Growth Rate	**CETIS Version:**	CETISv1.8.7
Analyzed: 21 Jun-17 10:49	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





CETIS Summary Report

Report Date: 21 Jun-17 11:59 (p 1 of 5)
Test Code: 170471b | 11-9861-4236

Neanthes 20-d Survival and Growth Sediment Test

Nautilus Environmental

Batch ID:	05-7709-2624	Test Type:	Survival-Growth	Analyst:	Jeslin Wijaya
Start Date:	26 May-17	Protocol:	PSEP (1995)	Diluent:	Natural seawater
Ending Date:	15 Jun-17	Species:	Neanthes arenaceodentata	Brine:	
Duration:	20d 0h	Source:	Aquatic Toxicology Support, WA	Age:	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (6.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-27	Sediment Sample	Golder	SED17-27		

Individual Growth Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-29	5	0.3977	0.314	0.4813	0.3301	0.4912	0.03012	0.06735	16.94%	0.0%
SED17-08	5	0.4148	0.302	0.5276	0.2969	0.5069	0.04062	0.09083	21.9%	-4.3%
SED17-06	5	0.4791	0.3773	0.581	0.3894	0.5879	0.03668	0.08202	17.12%	-20.49%
SED17-09	5	0.3805	0.2992	0.4617	0.3057	0.4677	0.02926	0.06543	17.2%	4.33%
SED17-13	5	0.4329	0.356	0.5099	0.3506	0.487	0.02772	0.06199	14.32%	-8.87%
SED17-17	5	0.4962	0.3937	0.5987	0.4014	0.6288	0.03691	0.08254	16.63%	-24.78%
SED17-20	5	0.431	0.3497	0.5123	0.3329	0.5105	0.02928	0.06548	15.19%	-8.37%
SED17-18	5	0.3851	0.3089	0.4612	0.3262	0.4673	0.02743	0.06133	15.93%	3.17%
SED17-19	5	0.3741	0.2788	0.4694	0.291	0.4447	0.03432	0.07675	20.52%	5.93%
SED17-24	5	0.4572	0.3852	0.5293	0.3813	0.5262	0.02595	0.05803	12.69%	-14.97%
SED17-12	5	0.3845	0.2963	0.4727	0.3203	0.4985	0.03176	0.07101	18.47%	3.31%
SED17-01	5	0.4522	0.3651	0.5392	0.3666	0.5463	0.03135	0.07011	15.5%	-13.71%
SED17-03	5	0.412	0.3282	0.4958	0.3421	0.5092	0.03018	0.06748	16.38%	-3.6%
SED17-27	5	0.5234	0.3978	0.649	0.3499	0.6159	0.04523	0.1011	19.32%	-31.62%

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-29	5	8.468	6.796	10.14	7.116	10.34	0.6024	1.347	15.91%	0.0%
SED17-08	5	8.81	6.555	11.07	6.452	10.65	0.8124	1.817	20.62%	-4.04%
SED17-06	5	10.1	8.061	12.13	8.304	12.27	0.7336	1.64	16.25%	-19.24%
SED17-09	5	8.124	6.499	9.749	6.63	9.87	0.5853	1.309	16.11%	4.07%
SED17-13	5	9.174	7.634	10.71	7.526	10.25	0.5544	1.24	13.51%	-8.33%
SED17-17	5	10.44	8.389	12.49	8.542	13.09	0.7383	1.651	15.81%	-23.27%
SED17-20	5	9.134	7.508	10.76	7.173	10.72	0.5857	1.31	14.34%	-7.86%
SED17-18	5	8.216	6.693	9.739	7.038	10.26	0.5485	1.227	14.93%	2.98%
SED17-19	5	7.996	6.091	9.902	6.334	9.408	0.6865	1.535	19.2%	5.57%
SED17-24	5	9.659	8.218	11.1	8.142	11.04	0.5191	1.161	12.02%	-14.06%
SED17-12	5	8.205	6.442	9.968	6.92	10.49	0.6351	1.42	17.31%	3.11%
SED17-01	5	9.559	7.818	11.3	7.848	11.44	0.6271	1.402	14.67%	-12.88%
SED17-03	5	8.755	7.079	10.43	7.358	10.7	0.6036	1.35	15.42%	-3.38%
SED17-27	5	10.98	8.472	13.49	7.512	12.83	0.9046	2.023	18.42%	-29.7%

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-29	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-08	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-06	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-09	5	0.92	0.784	1	0.8	1	0.04899	0.1095	11.91%	8.0%
SED17-13	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-17	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-20	5	0.84	0.6322	1	0.6	1	0.07483	0.1673	19.92%	16.0%
SED17-18	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-19	5	0.8	0.4488	1	0.4	1	0.1265	0.2828	35.36%	20.0%
SED17-24	5	1	1	1	1	1	0	0	0.0%	0.0%
SED17-12	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-01	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-03	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
SED17-27	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Total Dry Weight Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-29	5	42.34	33.98	50.7	35.58	51.7	3.012	6.735	15.91%	0.0%
SED17-08	5	44.05	32.77	55.33	32.26	53.26	4.062	9.083	20.62%	-4.04%
SED17-06	5	48.03	41.16	54.91	41.52	56.63	2.477	5.538	11.53%	-13.44%
SED17-09	5	37.8	25.7	49.91	26.52	49.35	4.36	9.75	25.79%	10.72%
SED17-13	5	45.87	38.17	53.56	37.63	51.27	2.772	6.199	13.51%	-8.33%
SED17-17	5	50.49	36.7	64.27	34.17	65.46	4.964	11.1	21.99%	-19.23%
SED17-20	5	38.85	25.51	52.19	21.52	48.98	4.803	10.74	27.64%	8.25%
SED17-18	5	39.03	35.93	42.13	35.19	41.39	1.117	2.497	6.4%	7.83%
SED17-19	5	32.51	15.47	49.54	12.68	47.04	6.135	13.72	42.2%	23.23%
SED17-24	5	48.3	41.09	55.5	40.71	55.19	2.595	5.803	12.02%	-14.06%
SED17-12	5	38.93	34.51	43.34	34.6	41.94	1.59	3.556	9.13%	8.06%
SED17-01	5	45.51	39.75	51.27	39.24	51.6	2.075	4.64	10.2%	-7.47%
SED17-03	5	41.98	32.6	51.37	35.81	53.5	3.38	7.559	18.0%	0.85%
SED17-27	5	53.41	36.81	70.01	30.05	64.16	5.979	13.37	25.03%	-26.15%

Neanthes 20-d Survival and Growth Sediment Test | Nautilus Environmental

Individual Growth Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	0.3301	0.4346	0.339	0.4912	0.3934
SED17-08	0.5032	0.4041	0.5069	0.3629	0.2969
SED17-06	0.3894	0.5406	0.4349	0.5879	0.4428
SED17-09	0.3057	0.3551	0.4677	0.4269	0.3469
SED17-13	0.3506	0.3825	0.487	0.4703	0.4743
SED17-17	0.4946	0.6288	0.4791	0.4014	0.477
SED17-20	0.3329	0.464	0.5105	0.4215	0.4257
SED17-18	0.3881	0.3572	0.3262	0.3665	0.4873
SED17-19	0.291	0.4447	0.2913	0.4333	0.4102
SED17-24	0.3813	0.4374	0.5262	0.5038	0.4373
SED17-12	0.3848	0.3895	0.3203	0.3296	0.4985
SED17-01	0.5463	0.4508	0.4902	0.407	0.3666
SED17-03	0.4219	0.3541	0.5092	0.4326	0.3421
SED17-27	0.5484	0.5565	0.3499	0.6159	0.5464

Mean Dry Weight-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	7.116	9.206	7.296	10.34	8.384
SED17-08	10.58	8.598	10.65	7.772	6.452
SED17-06	8.304	11.33	9.214	12.27	9.372
SED17-09	6.63	7.616	9.87	9.052	7.452
SED17-13	7.526	8.164	10.25	9.922	10
SED17-17	10.41	13.09	10.1	8.542	10.05
SED17-20	7.173	9.796	10.72	8.946	9.03
SED17-18	8.278	7.658	7.038	7.846	10.26
SED17-19	6.334	9.408	6.34	9.18	8.72
SED17-24	8.142	9.262	11.04	10.59	9.262
SED17-12	8.21	8.304	6.92	7.106	10.49
SED17-01	11.44	9.532	10.32	8.654	7.848
SED17-03	8.952	7.596	10.7	9.166	7.358
SED17-27	11.48	11.65	7.512	12.83	11.44

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	1	1	1	1	1
SED17-08	1	1	1	1	1
SED17-06	1	1	1	0.8	1
SED17-09	0.8	1	1	1	0.8
SED17-13	1	1	1	1	1
SED17-17	1	1	1	0.8	1
SED17-20	0.6	1	0.8	1	0.6
SED17-18	1	1	1	1	0.8
SED17-19	1	1	0.4	0.6	1
SED17-24	1	1	1	1	1
SED17-12	1	1	1	1	0.8
SED17-01	0.8	1	1	1	1
SED17-03	0.8	1	1	1	1
SED17-27	1	1	0.8	1	1

Total Dry Weight Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	35.58	46.03	36.48	51.7	41.92
SED17-08	52.89	42.99	53.26	38.86	32.26
SED17-06	41.52	56.63	46.07	49.09	46.86
SED17-09	26.52	38.08	49.35	45.26	29.81
SED17-13	37.63	40.82	51.27	49.61	50.01
SED17-17	52.04	65.46	50.49	34.17	50.27
SED17-20	21.52	48.98	42.9	44.73	36.12
SED17-18	41.39	38.29	35.19	39.23	41.04
SED17-19	31.67	47.04	12.68	27.54	43.6
SED17-24	40.71	46.31	55.19	52.96	46.31
SED17-12	41.05	41.52	34.6	35.53	41.94
SED17-01	45.76	47.66	51.6	43.27	39.24
SED17-03	35.81	37.98	53.5	45.83	36.79
SED17-27	57.41	58.23	30.05	64.16	57.22

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	5/5	5/5	5/5	5/5	5/5
SED17-08	5/5	5/5	5/5	5/5	5/5
SED17-06	5/5	5/5	5/5	4/5	5/5
SED17-09	4/5	5/5	5/5	5/5	4/5
SED17-13	5/5	5/5	5/5	5/5	5/5
SED17-17	5/5	5/5	5/5	4/5	5/5
SED17-20	3/5	5/5	4/5	5/5	4/5
SED17-18	5/5	5/5	5/5	5/5	4/5
SED17-19	5/5	5/5	2/5	3/5	5/5
SED17-24	5/5	5/5	5/5	5/5	5/5
SED17-12	5/5	5/5	5/5	5/5	4/5
SED17-01	4/5	5/5	5/5	5/5	5/5
SED17-03	4/5	5/5	5/5	5/5	5/5
SED17-27	5/5	5/5	4/5	5/5	5/5

CETIS Analytical Report

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	11-4586-0682	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:56	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Batch ID:	05-7709-2624	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	

Kolmogorov-Smirnov Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-29		SED17-08	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-06	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-09	0.4	NA		8	0.4365	CDF	Non-Significant Effect
		SED17-13	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-17	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-20	0.6	NA		8	0.1786	CDF	Non-Significant Effect
		SED17-18	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-19	0.4	NA		8	0.4365	CDF	Non-Significant Effect
		SED17-24	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-12	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-01	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-03	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-27	0.2	NA		8	0.5000	CDF	Non-Significant Effect

Analyst: JW QA: Jun 24/17

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	11-4586-0682	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:56	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.2987423	0.02298018	13	1.382	0.1973	Non-Significant Effect
Error	0.9313147	0.01663062	56			
Total	1.230057		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1.378	2.586	0.2102	Equal Variances
Variances	Levene Equality of Variance	7.628	2.465	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.8318	0.9526	<0.0001	Non-normal Distribution

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-29	5	1	1	1	1	1	1	0	0.0%	0.0%
SED17-08	5	1	1	1	1	1	1	0	0.0%	0.0%
SED17-06	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-09	5	0.92	0.784	1	1	0.8	1	0.04899	11.91%	8.0%
SED17-13	5	1	1	1	1	1	1	0	0.0%	0.0%
SED17-17	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-20	5	0.84	0.6322	1	0.8	0.6	1	0.07483	19.92%	16.0%
SED17-18	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-19	5	0.8	0.4488	1	1	0.4	1	0.1265	35.36%	20.0%
SED17-24	5	1	1	1	1	1	1	0	0.0%	0.0%
SED17-12	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-01	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-03	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
SED17-27	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-29	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
SED17-08	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
SED17-06	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-09	5	1.25	1.088	1.412	1.345	1.107	1.345	0.05833	10.43%	7.08%
SED17-13	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
SED17-17	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-20	5	1.158	0.9183	1.398	1.107	0.8861	1.345	0.08639	16.68%	13.91%
SED17-18	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-19	5	1.121	0.7304	1.512	1.345	0.6847	1.345	0.1408	28.08%	16.65%
SED17-24	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
SED17-12	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-01	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-03	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%
SED17-27	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	3.54%

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	11-4586-0682	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:56	Analysis:	Nonparametric-Two Sample	Official Results:	Yes

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	1	1	1	1	1
SED17-08	1	1	1	1	1
SED17-06	1	1	1	0.8	1
SED17-09	0.8	1	1	1	0.8
SED17-13	1	1	1	1	1
SED17-17	1	1	1	0.8	1
SED17-20	0.6	1	0.8	1	0.8
SED17-18	1	1	1	1	0.8
SED17-19	1	1	0.4	0.6	1
SED17-24	1	1	1	1	1
SED17-12	1	1	1	1	0.8
SED17-01	0.8	1	1	1	1
SED17-03	0.8	1	1	1	1
SED17-27	1	1	0.8	1	1

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	1.345	1.345	1.345	1.345	1.345
SED17-08	1.345	1.345	1.345	1.345	1.345
SED17-06	1.345	1.345	1.345	1.107	1.345
SED17-09	1.107	1.345	1.345	1.345	1.107
SED17-13	1.345	1.345	1.345	1.345	1.345
SED17-17	1.345	1.345	1.345	1.107	1.345
SED17-20	0.8861	1.345	1.107	1.345	1.107
SED17-18	1.345	1.345	1.345	1.345	1.107
SED17-19	1.345	1.345	0.6847	0.8861	1.345
SED17-24	1.345	1.345	1.345	1.345	1.345
SED17-12	1.345	1.345	1.345	1.345	1.107
SED17-01	1.107	1.345	1.345	1.345	1.345
SED17-03	1.107	1.345	1.345	1.345	1.345
SED17-27	1.345	1.345	1.107	1.345	1.345

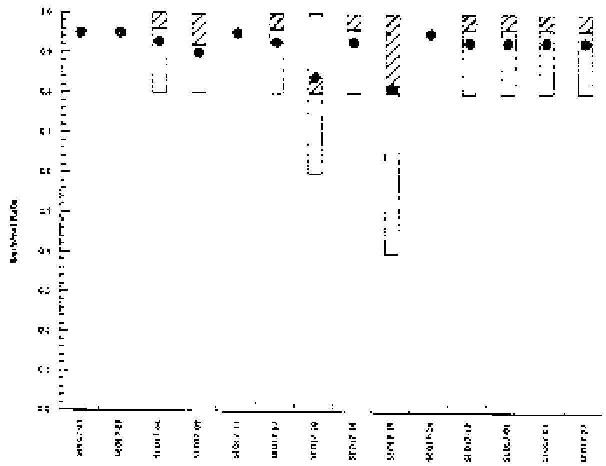
Survival Rate Binomials

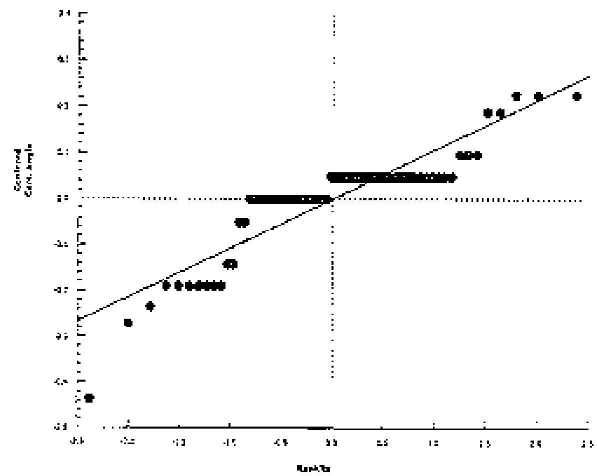
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	5/5	5/5	5/5	5/5	5/5
SED17-08	5/5	5/5	5/5	5/5	5/5
SED17-06	5/5	5/5	5/5	4/5	5/5
SED17-09	4/5	5/5	5/5	5/5	4/5
SED17-13	5/5	5/5	5/5	5/5	5/5
SED17-17	5/5	5/5	5/5	4/5	5/5
SED17-20	3/5	5/5	4/5	5/5	4/5
SED17-18	5/5	5/5	5/5	5/5	4/5
SED17-19	5/5	5/5	2/5	3/5	5/5
SED17-24	5/5	5/5	5/5	5/5	5/5
SED17-12	5/5	5/5	5/5	5/5	4/5
SED17-01	4/5	5/5	5/5	5/5	5/5
SED17-03	4/5	5/5	5/5	5/5	5/5
SED17-27	5/5	5/5	4/5	5/5	5/5

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	11-4586-0682	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:56	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Report Date: 21 Jun-17 11:59 (p 1 of 3)
Test Code: 170471b | 11-9861-4236

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	01-3789-5262	Endpoint:	Total Dry Weight	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	Analysis:	Parametric-Two Sample	Official Results:	Yes

Batch ID:	05-7709-2624	Test Type:	Survival-Growth	Analyst:	Jeslin Wijaya
Start Date:	26 May-17	Protocol:	PSEP (1995)	Diluent:	Natural seawater
Ending Date:	15 Jun-17	Species:	Neanthes arenaceodentata	Brine:	
Duration:	20d 0h	Source:	Aquatic Toxicology Support, WA	Age:	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8236	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	29.4%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-29		SED17-08	-0.3381	1.86	9.404	8	0.6280	CDF	Non-Significant Effect
		SED17-06	-1.46	1.86	7.251	8	0.9086	CDF	Non-Significant Effect
		SED17-09	0.8563	1.86	9.854	8	0.2084	CDF	Non-Significant Effect
		SED17-13	-0.8614	1.86	7.612	8	0.7929	CDF	Non-Significant Effect
		SED17-17	-1.403	1.86	10.8	8	0.9008	CDF	Non-Significant Effect
		SED17-20	0.616	1.86	10.54	8	0.2775	CDF	Non-Significant Effect
		SED17-18	1.032	1.86	5.973	8	0.1662	CDF	Non-Significant Effect
		SED17-19	1.439	1.86	12.71	8	0.0940	CDF	Non-Significant Effect
		SED17-24	-1.498	1.86	7.393	8	0.9137	CDF	Non-Significant Effect
		SED17-12	1.002	1.86	6.334	8	0.1728	CDF	Non-Significant Effect
		SED17-01	-0.8651	1.86	6.801	8	0.7939	CDF	Non-Significant Effect
		SED17-03	0.07951	1.86	8.419	8	0.4693	CDF	Non-Significant Effect
		SED17-27	-1.654	1.86	12.45	8	0.9316	CDF	Non-Significant Effect

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	01-3789-5262	**Endpoint:**	Total Dry Weight	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2099.04	161.4646	13	2.197	0.0216	Significant Effect
Error	4114.933	73.48094	56			
Total	6213.974		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	19.54	27.69	0.1074	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9713	0.9526	0.1078	Normal Distribution

Total Dry Weight Summary

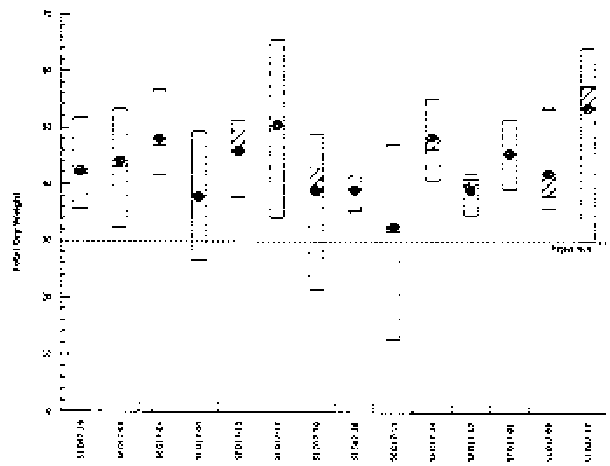
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-29	5	42.34	33.98	50.7	41.92	35.58	51.7	3.012	15.91%	0.0%
SED17-08	5	44.05	32.77	55.33	42.99	32.26	53.26	4.062	20.62%	-4.04%
SED17-06	5	48.03	41.16	54.91	46.86	41.52	56.63	2.477	11.53%	-13.44%
SED17-09	5	37.8	25.7	49.91	38.08	26.52	49.35	4.36	25.79%	10.72%
SED17-13	5	45.87	38.17	53.56	49.61	37.63	51.27	2.772	13.51%	-8.33%
SED17-17	5	50.49	36.7	64.27	50.49	34.17	65.46	4.964	21.99%	-19.23%
SED17-20	5	38.85	25.51	52.19	42.9	21.52	48.98	4.803	27.64%	8.25%
SED17-18	5	39.03	35.93	42.13	39.23	35.19	41.39	1.117	6.4%	7.83%
SED17-19	5	32.51	15.47	49.54	31.67	12.68	47.04	6.135	42.2%	23.23%
SED17-24	5	48.3	41.09	55.5	46.31	40.71	55.19	2.595	12.02%	-14.06%
SED17-12	5	38.93	34.51	43.34	41.05	34.6	41.94	1.59	9.13%	8.06%
SED17-01	5	45.51	39.75	51.27	45.76	39.24	51.6	2.075	10.2%	-7.47%
SED17-03	5	41.98	32.6	51.37	37.98	35.81	53.5	3.38	18.0%	0.85%
SED17-27	5	53.41	36.81	70.01	57.41	30.05	64.16	5.979	25.03%	-26.15%

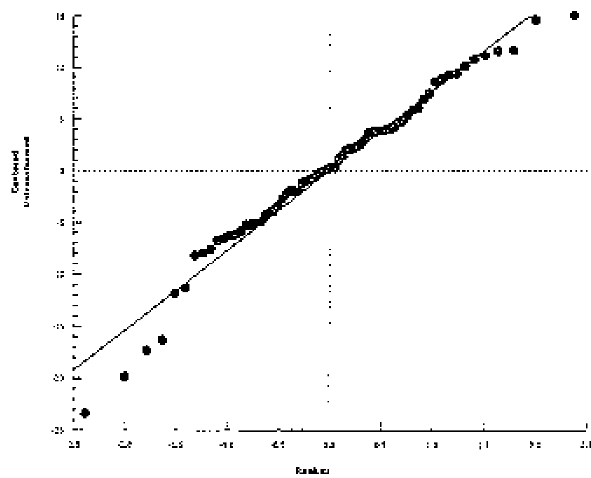
Total Dry Weight Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	35.58	46.03	36.48	51.7	41.92
SED17-08	52.89	42.99	53.26	38.86	32.26
SED17-06	41.52	56.63	46.07	49.09	46.86
SED17-09	26.52	38.08	49.35	45.26	29.81
SED17-13	37.63	40.82	51.27	49.61	50.01
SED17-17	52.04	65.46	50.49	34.17	50.27
SED17-20	21.52	48.98	42.9	44.73	36.12
SED17-18	41.39	38.29	35.19	39.23	41.04
SED17-19	31.67	47.04	12.68	27.54	43.6
SED17-24	40.71	46.31	55.19	52.96	46.31
SED17-12	41.05	41.52	34.6	35.53	41.94
SED17-01	45.76	47.66	51.6	43.27	39.24
SED17-03	35.81	37.98	53.5	45.83	36.79
SED17-27	57.41	58.23	30.05	64.16	57.22

Analysis ID:	01-3789-5262	**Endpoint:**	Total Dry Weight	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





CETIS Analytical Report

		Report Date:	21 Jun-17 11:27 (p 1 of 3)
		Test Code:	170471b | 11-9861-4236

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	06-5594-5652	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:56	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes
Batch ID:	05-7709-2624	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	23.9%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-29		SED17-08	-0.3381	1.86	1.881	8	0.6280	CDF	Non-Significant Effect
		SED17-06	-1.716	1.86	1.765	8	0.9378	CDF	Non-Significant Effect
		SED17-09	0.4099	1.86	1.562	8	0.3463	CDF	Non-Significant Effect
		SED17-13	-0.8614	1.86	1.522	8	0.7929	CDF	Non-Significant Effect
		SED17-17	-2.068	1.86	1.772	8	0.9638	CDF	Non-Significant Effect
		SED17-20	-0.7923	1.86	1.562	8	0.7745	CDF	Non-Significant Effect
		SED17-18	0.3098	1.86	1.515	8	0.3823	CDF	Non-Significant Effect
		SED17-19	0.5168	1.86	1.698	8	0.3096	CDF	Non-Significant Effect
		SED17-24	-1.498	1.86	1.479	8	0.9137	CDF	Non-Significant Effect
		SED17-12	0.3009	1.86	1.628	8	0.3856	CDF	Non-Significant Effect
		SED17-01	-1.254	1.86	1.617	8	0.8774	CDF	Non-Significant Effect
		SED17-03	-0.3355	1.86	1.586	8	0.6271	CDF	Non-Significant Effect
		SED17-27	-2.314	1.86	2.021	8	0.9753	CDF	Non-Significant Effect

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	06-5594-5652	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:56	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	56.08031	4.31387	13	1.974	0.0406	Significant Effect
Error	122.3938	2.185603	56			
Total	178.4741		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	2.599	27.69	0.9990	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9792	0.9526	0.2955	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-29	5	8.468	6.796	10.14	8.384	7.116	10.34	0.6024	15.91%	0.0%
SED17-08	5	8.81	6.555	11.07	8.598	6.452	10.65	0.8124	20.62%	-4.04%
SED17-06	5	10.1	8.061	12.13	9.372	8.304	12.27	0.7336	16.25%	-19.24%
SED17-09	5	8.124	6.499	9.749	7.616	6.63	9.87	0.5863	16.11%	4.07%
SED17-13	5	9.174	7.634	10.71	9.922	7.526	10.25	0.5544	13.51%	-8.33%
SED17-17	5	10.44	8.389	12.49	10.1	8.542	13.09	0.7383	15.81%	-23.27%
SED17-20	5	9.134	7.508	10.76	9.03	7.173	10.72	0.5857	14.34%	-7.86%
SED17-18	5	8.216	6.693	9.739	7.846	7.038	10.26	0.5485	14.93%	2.98%
SED17-19	5	7.996	6.091	9.902	8.72	6.334	9.408	0.6865	19.2%	5.57%
SED17-24	5	9.659	8.218	11.1	9.262	8.142	11.04	0.5191	12.02%	-14.06%
SED17-12	5	8.205	6.442	9.968	8.21	6.92	10.49	0.6351	17.31%	3.11%
SED17-01	5	9.559	7.818	11.3	9.532	7.848	11.44	0.6271	14.67%	-12.88%
SED17-03	5	8.755	7.079	10.43	8.952	7.358	10.7	0.6036	15.42%	-3.38%
SED17-27	5	10.98	8.472	13.49	11.48	7.512	12.83	0.9046	18.42%	-29.7%

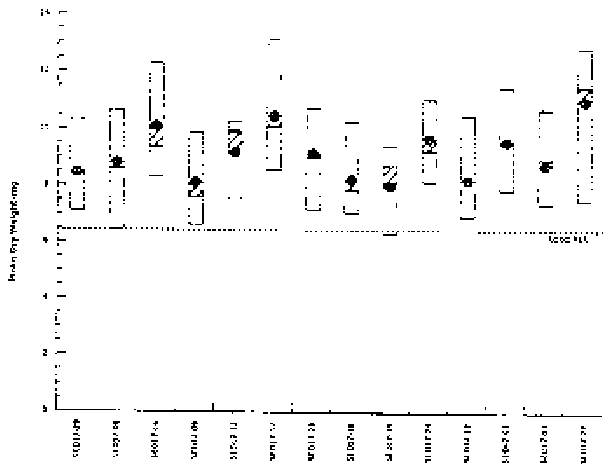
Mean Dry Weight-mg Detail

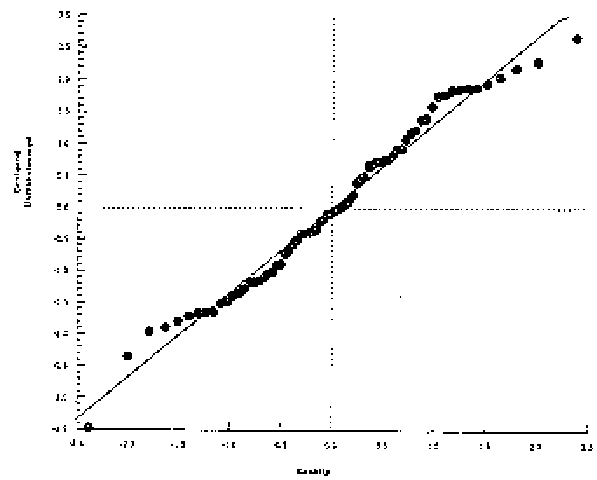
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	7.116	9.206	7.296	10.34	8.384
SED17-08	10.58	8.598	10.65	7.772	6.452
SED17-06	8.304	11.33	9.214	12.27	9.372
SED17-09	6.63	7.616	9.87	9.052	7.452
SED17-13	7.526	8.164	10.25	9.922	10
SED17-17	10.41	13.09	10.1	8.542	10.05
SED17-20	7.173	9.796	10.72	8.946	9.03
SED17-18	8.278	7.658	7.038	7.846	10.26
SED17-19	6.334	9.408	6.34	9.18	8.72
SED17-24	8.142	9.262	11.04	10.59	9.262
SED17-12	8.21	8.304	6.92	7.106	10.49
SED17-01	11.44	9.532	10.32	8.654	7.848
SED17-03	8.952	7.596	10.7	9.166	7.358
SED17-27	11.48	11.65	7.512	12.83	11.44

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	06-5594-5652	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:56	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	12-2753-7472	**Endpoint:**	Individual Growth Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:56	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Batch ID:	05-7709-2624	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-6235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5643	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-8632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	06-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-29	Sediment Sample	Golder	SED17-29		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-27	Sediment Sample	Golder	SED17-27		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	25.4%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-29		SED17-08	-0.3381	1.86	0.094	8	0.6280	CDF	Non-Significant Effect
		SED17-06	-1.716	1.86	0.088	8	0.9378	CDF	Non-Significant Effect
		SED17-09	0.4099	1.86	0.078	8	0.3463	CDF	Non-Significant Effect
		SED17-13	-0.8614	1.86	0.076	8	0.7929	CDF	Non-Significant Effect
		SED17-17	-2.068	1.86	0.089	8	0.9638	CDF	Non-Significant Effect
		SED17-20	-0.7923	1.86	0.078	8	0.7745	CDF	Non-Significant Effect
		SED17-18	0.3098	1.86	0.076	8	0.3823	CDF	Non-Significant Effect
		SED17-19	0.5168	1.86	0.085	8	0.3096	CDF	Non-Significant Effect
		SED17-24	-1.498	1.86	0.074	8	0.9137	CDF	Non-Significant Effect
		SED17-12	0.3009	1.86	0.081	8	0.3856	CDF	Non-Significant Effect
		SED17-01	-1.254	1.86	0.081	8	0.8774	CDF	Non-Significant Effect
		SED17-03	-0.3355	1.86	0.079	8	0.6271	CDF	Non-Significant Effect
		SED17-27	-2.314	1.86	0.101	8	0.9753	CDF	Non-Significant Effect

Analyst: JW QA: July 24/17

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	12-2753-7472	Endpoint:	Individual Growth Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 10:56	Analysis:	Parametric-Two Sample	Official Results:	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.1402008	0.01078467	13	1.974	0.0406	Significant Effect
Error	0.3059843	0.005464006	56			
Total	0.4461851		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	2.599	27.69	0.9990	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9792	0.9526	0.2955	Normal Distribution

Individual Growth Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-29	5	0.3977	0.314	0.4813	0.3934	0.3301	0.4912	0.03012	16.94%	0.0%
SED17-08	5	0.4148	0.302	0.5276	0.4041	0.2969	0.5069	0.04062	21.9%	-4.3%
SED17-06	5	0.4791	0.3773	0.581	0.4428	0.3894	0.5879	0.03668	17.12%	-20.49%
SED17-09	5	0.3805	0.2992	0.4617	0.3551	0.3057	0.4677	0.02926	17.2%	4.33%
SED17-13	5	0.4329	0.356	0.5099	0.4703	0.3506	0.487	0.02772	14.32%	-8.87%
SED17-17	5	0.4962	0.3937	0.5987	0.4791	0.4014	0.6288	0.03691	16.63%	-24.78%
SED17-20	5	0.431	0.3497	0.5123	0.4257	0.3329	0.5105	0.02928	15.19%	-8.37%
SED17-18	5	0.3851	0.3089	0.4612	0.3665	0.3262	0.4873	0.02743	15.93%	3.17%
SED17-19	5	0.3741	0.2788	0.4694	0.4102	0.291	0.4447	0.03432	20.52%	5.93%
SED17-24	5	0.4572	0.3852	0.5293	0.4374	0.3813	0.5262	0.02595	12.69%	-14.97%
SED17-12	5	0.3845	0.2963	0.4727	0.3848	0.3203	0.4985	0.03176	18.47%	3.31%
SED17-01	5	0.4522	0.3651	0.5392	0.4508	0.3666	0.5463	0.03135	15.5%	-13.71%
SED17-03	5	0.412	0.3282	0.4958	0.4219	0.3421	0.5092	0.03018	16.38%	-3.6%
SED17-27	5	0.5234	0.3978	0.649	0.5484	0.3499	0.6159	0.04523	19.32%	-31.62%

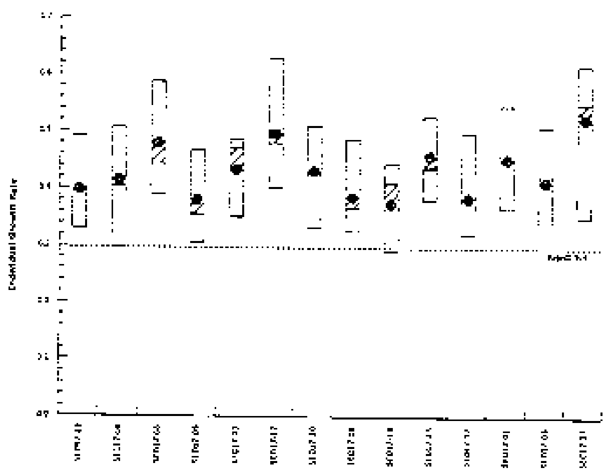
Individual Growth Rate Detail

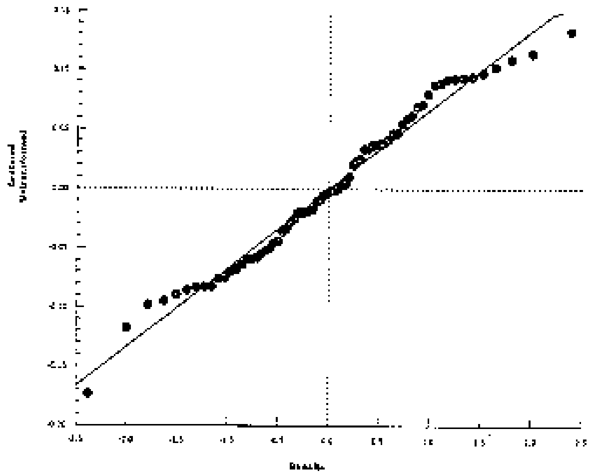
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-29	0.3301	0.4346	0.339	0.4912	0.3934
SED17-08	0.5032	0.4041	0.5069	0.3629	0.2969
SED17-06	0.3894	0.5406	0.4349	0.5879	0.4428
SED17-09	0.3057	0.3551	0.4677	0.4269	0.3469
SED17-13	0.3506	0.3825	0.487	0.4703	0.4743
SED17-17	0.4946	0.6288	0.4791	0.4014	0.477
SED17-20	0.3329	0.464	0.5105	0.4215	0.4257
SED17-18	0.3881	0.3572	0.3262	0.3665	0.4873
SED17-19	0.291	0.4447	0.2913	0.4333	0.4102
SED17-24	0.3813	0.4374	0.5262	0.5038	0.4373
SED17-12	0.3848	0.3895	0.3203	0.3296	0.4985
SED17-01	0.5463	0.4508	0.4902	0.407	0.3666
SED17-03	0.4219	0.3541	0.5092	0.4326	0.3421
SED17-27	0.5484	0.5565	0.3499	0.6159	0.5464

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	12-2753-7472	**Endpoint:**	Individual Growth Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 10:56	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





CETIS Summary Report

Report Date:	21 Jun-17 11:59 (p 1 of 5)		
Test Code:	170471c | 11-9348-3710		

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Batch ID:	09-2852-2152	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4858-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-27	Sediment Sample	Golder	SED17-27		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Individual Growth Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-27	5	0.5234	0.3978	0.649	0.3499	0.6159	0.04523	0.1011	19.32%	0.0%
SED17-08	5	0.4148	0.302	0.5276	0.2969	0.5069	0.04062	0.09083	21.9%	20.76%
SED17-06	5	0.4791	0.3773	0.581	0.3894	0.5879	0.03668	0.08202	17.12%	8.46%
SED17-09	5	0.3805	0.2992	0.4617	0.3057	0.4677	0.02926	0.06543	17.2%	27.31%
SED17-13	5	0.4329	0.356	0.5099	0.3506	0.487	0.02772	0.06199	14.32%	17.29%
SED17-17	5	0.4962	0.3937	0.5987	0.4014	0.6286	0.03691	0.08254	16.63%	5.2%
SED17-20	5	0.431	0.3497	0.5123	0.3329	0.5105	0.02928	0.06548	15.19%	17.67%
SED17-18	5	0.3851	0.3089	0.4612	0.3262	0.4673	0.02743	0.06133	15.93%	26.44%
SED17-19	5	0.3741	0.2788	0.4694	0.291	0.4447	0.03432	0.07675	20.52%	28.53%
SED17-24	5	0.4572	0.3852	0.5293	0.3813	0.5262	0.02595	0.05803	12.69%	12.65%
SED17-12	5	0.3845	0.2963	0.4727	0.3203	0.4985	0.03176	0.07101	18.47%	26.54%
SED17-01	5	0.4522	0.3651	0.5392	0.3666	0.5463	0.03135	0.07011	15.5%	13.61%
SED17-03	5	0.412	0.3282	0.4958	0.3421	0.5092	0.03018	0.06748	16.38%	21.29%
SED17-29	5	0.3977	0.314	0.4813	0.3301	0.4912	0.03012	0.06735	16.94%	24.02%

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-27	5	10.98	8.472	13.49	7.512	12.83	0.9046	2.023	18.42%	0.0%
SED17-08	5	8.81	6.555	11.07	6.452	10.65	0.8124	1.817	20.62%	19.78%
SED17-06	5	10.1	8.061	12.13	8.304	12.27	0.7336	1.64	16.25%	8.06%
SED17-09	5	8.124	6.499	9.749	6.63	9.87	0.5853	1.309	16.11%	26.03%
SED17-13	5	9.174	7.634	10.71	7.526	10.25	0.5544	1.24	13.51%	16.46%
SED17-17	5	10.44	8.389	12.49	8.542	13.09	0.7383	1.651	15.81%	4.96%
SED17-20	5	9.134	7.508	10.76	7.173	10.72	0.5857	1.31	14.34%	16.84%
SED17-18	5	8.216	6.693	9.739	7.038	10.26	0.5485	1.227	14.93%	25.2%
SED17-19	5	7.996	6.091	9.902	6.334	9.408	0.6865	1.535	19.2%	27.19%
SED17-24	5	9.659	8.218	11.1	8.142	11.04	0.5191	1.161	12.02%	12.06%
SED17-12	5	8.205	6.442	9.968	6.92	10.49	0.6351	1.42	17.31%	25.3%
SED17-01	5	9.559	7.818	11.3	7.848	11.44	0.6271	1.402	14.67%	12.97%
SED17-03	5	8.755	7.079	10.43	7.358	10.7	0.6036	1.35	15.42%	20.29%
SED17-29	5	8.468	6.796	10.14	7.116	10.34	0.6024	1.347	15.91%	22.9%

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-27	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-08	5	1	1	1	1	1	0	0	0.0%	-4.17%
SED17-06	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-09	5	0.92	0.784	1	0.8	1	0.04899	0.1095	11.91%	4.17%
SED17-13	5	1	1	1	1	1	0	0	0.0%	-4.17%
SED17-17	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-20	5	0.84	0.6322	1	0.6	1	0.07483	0.1673	19.92%	12.5%
SED17-18	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-19	5	0.8	0.4488	1	0.4	1	0.1265	0.2828	35.36%	16.67%
SED17-24	5	1	1	1	1	1	0	0	0.0%	-4.17%
SED17-12	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-01	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-03	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	0.0%
SED17-29	5	1	1	1	1	1	0	0	0.0%	-4.17%

Total Dry Weight Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
SED17-27	5	53.41	36.81	70.01	30.05	64.16	5.979	13.37	25.03%	0.0%
SED17-08	5	44.05	32.77	55.33	32.26	53.26	4.062	9.083	20.62%	17.53%
SED17-06	5	48.03	41.16	54.91	41.52	56.63	2.477	5.538	11.53%	10.07%
SED17-09	5	37.8	25.7	49.91	26.52	49.35	4.36	9.75	25.79%	29.22%
SED17-13	5	45.87	38.17	53.56	37.63	51.27	2.772	6.199	13.51%	14.13%
SED17-17	5	50.49	36.7	64.27	34.17	65.46	4.964	11.1	21.99%	5.48%
SED17-20	5	38.85	25.51	52.19	21.52	48.98	4.803	10.74	27.64%	27.27%
SED17-16	5	39.03	35.93	42.13	35.19	41.39	1.117	2.497	6.4%	26.93%
SED17-19	5	32.51	15.47	49.54	12.68	47.04	6.135	13.72	42.2%	39.14%
SED17-24	5	48.3	41.09	55.5	40.71	55.19	2.595	5.803	12.02%	9.58%
SED17-12	5	38.93	34.51	43.34	34.6	41.94	1.59	3.556	9.13%	27.12%
SED17-01	5	45.51	39.75	51.27	39.24	51.6	2.075	4.64	10.2%	14.81%
SED17-03	5	41.98	32.6	51.37	35.81	53.5	3.38	7.559	18.0%	21.4%
SED17-29	5	42.34	33.98	50.7	35.58	51.7	3.012	6.735	15.91%	20.73%

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Individual Growth Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	0.5484	0.5565	0.3499	0.6159	0.5464
SED17-08	0.5032	0.4041	0.5069	0.3629	0.2969
SED17-06	0.3894	0.5406	0.4349	0.5879	0.4428
SED17-09	0.3057	0.3551	0.4677	0.4269	0.3469
SED17-13	0.3506	0.3825	0.487	0.4703	0.4743
SED17-17	0.4946	0.6288	0.4791	0.4014	0.477
SED17-20	0.3329	0.464	0.5105	0.4215	0.4257
SED17-18	0.3881	0.3572	0.3262	0.3665	0.4873
SED17-19	0.291	0.4447	0.2913	0.4333	0.4102
SED17-24	0.3813	0.4374	0.5262	0.5038	0.4373
SED17-12	0.3848	0.3895	0.3203	0.3296	0.4985
SED17-01	0.5463	0.4508	0.4902	0.407	0.3666
SED17-03	0.4219	0.3541	0.5092	0.4326	0.3421
SED17-29	0.3301	0.4346	0.339	0.4912	0.3934

Mean Dry Weight-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	11.48	11.65	7.512	12.83	11.44
SED17-08	10.58	8.598	10.65	7.772	6.452
SED17-06	8.304	11.33	9.214	12.27	9.372
SED17-09	6.63	7.616	9.87	9.052	7.452
SED17-13	7.526	8.164	10.25	9.922	10
SED17-17	10.41	13.09	10.1	8.542	10.05
SED17-20	7.173	9.796	10.72	8.946	9.03
SED17-18	8.278	7.658	7.038	7.846	10.26
SED17-19	6.334	9.408	6.34	9.18	8.72
SED17-24	8.142	9.262	11.04	10.59	9.262
SED17-12	8.21	8.304	6.92	7.106	10.49
SED17-01	11.44	9.532	10.32	8.654	7.848
SED17-03	8.952	7.596	10.7	9.166	7.358
SED17-29	7.116	9.206	7.296	10.34	8.384

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	1	1	0.8	1	1
SED17-08	1	1	1	1	1
SED17-06	1	1	1	0.8	1
SED17-09	0.8	1	1	1	0.8
SED17-13	1	1	1	1	1
SED17-17	1	1	1	0.8	1
SED17-20	0.6	1	0.8	1	0.8
SED17-18	1	1	1	1	0.8
SED17-19	1	1	0.4	0.6	1
SED17-24	1	1	1	1	1
SED17-12	1	1	1	1	0.8
SED17-01	0.8	1	1	1	1
SED17-03	0.8	1	1	1	1
SED17-29	1	1	1	1	1

Total Dry Weight Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	57.41	58.23	30.05	64.16	57.22
SED17-08	52.89	42.99	53.26	38.86	32.26
SED17-06	41.52	56.63	46.07	49.09	46.86
SED17-09	26.52	36.08	49.35	45.26	29.81
SED17-13	37.63	40.82	51.27	49.61	50.01
SED17-17	52.04	65.46	50.49	34.17	50.27
SED17-20	21.52	48.98	42.9	44.73	36.12
SED17-18	41.39	38.29	35.19	39.23	41.04
SED17-19	31.67	47.04	12.68	27.54	43.6
SED17-24	40.71	46.31	55.19	52.96	46.31
SED17-12	41.05	41.52	34.6	35.53	41.94
SED17-01	45.76	47.66	51.6	43.27	39.24
SED17-03	35.81	37.98	53.5	45.83	36.79
SED17-29	35.58	46.03	36.48	51.7	41.92

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	5/5	5/5	4/5	5/5	5/5
SED17-08	5/5	5/5	5/5	5/5	5/5
SED17-06	5/5	5/5	5/5	4/5	5/5
SED17-09	4/5	5/5	5/5	5/5	4/5
SED17-13	5/5	5/5	5/5	5/5	5/5
SED17-17	5/5	5/5	5/5	4/5	5/5
SED17-20	3/5	5/5	4/5	5/5	4/5
SED17-18	5/5	5/5	5/5	5/5	4/5
SED17-19	5/5	5/5	2/5	3/5	5/5
SED17-24	5/5	5/5	5/5	5/5	5/5
SED17-12	5/5	5/5	5/5	5/5	4/5
SED17-01	4/5	5/5	5/5	5/5	5/5
SED17-03	4/5	5/5	5/5	5/5	5/5
SED17-29	5/5	5/5	5/5	5/5	5/5

CETIS Analytical Report

Report Date:	21 Jun-17 11:32 (p 1 of 4)
Test Code:	170471c | 11-9348-3710

Neanthes 20-d Survival and Growth Sediment Test | **Nautilus Environmental**

Analysis ID:	01-3248-6546	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:02	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes
Batch ID:	09-2852-2152	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-27	Sediment Sample	Golder	SED17-27		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	

Kolmogorov-Smirnov Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-27		SED17-08	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-06	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-09	0.2	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-13	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-17	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-20	0.4	NA		8	0.4365	CDF	Non-Significant Effect
		SED17-18	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-19	0.4	NA		8	0.4365	CDF	Non-Significant Effect
		SED17-24	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-12	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-01	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-03	0	NA		8	0.5000	CDF	Non-Significant Effect
		SED17-29	0	NA		8	0.5000	CDF	Non-Significant Effect

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	01-3248-6546	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:02	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.2987423	0.02298018	13	1.382	0.1973	Non-Significant Effect
Error	0.9313147	0.01663062	56			
Total	1.230057		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1.378	2.586	0.2102	Equal Variances
Variances	Levene Equality of Variance	7.628	2.465	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.8318	0.9528	<0.0001	Non-normal Distribution

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-27	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-08	5	1	1	1	1	1	1	0	0.0%	-4.17%
SED17-06	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-09	5	0.92	0.784	1	1	0.8	1	0.04899	11.91%	4.17%
SED17-13	5	1	1	1	1	1	1	0	0.0%	-4.17%
SED17-17	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-20	5	0.84	0.6322	1	0.8	0.6	1	0.07483	19.92%	12.5%
SED17-18	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-19	5	0.8	0.4488	1	1	0.4	1	0.1265	35.36%	16.67%
SED17-24	5	1	1	1	1	1	1	0	0.0%	-4.17%
SED17-12	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-01	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-03	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	0.0%
SED17-29	5	1	1	1	1	1	1	0	0.0%	-4.17%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-27	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-08	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	-3.67%
SED17-06	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-09	5	1.25	1.088	1.412	1.345	1.107	1.345	0.05833	10.43%	3.67%
SED17-13	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	-3.67%
SED17-17	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-20	5	1.158	0.9183	1.398	1.107	0.8861	1.345	0.08639	16.68%	10.75%
SED17-18	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-19	5	1.121	0.7304	1.512	1.345	0.6847	1.345	0.1408	28.08%	13.59%
SED17-24	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	-3.67%
SED17-12	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-01	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-03	5	1.298	1.165	1.43	1.345	1.107	1.345	0.04763	8.21%	0.0%
SED17-29	5	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	-3.67%

Analysis ID: 01-3248-6546 Endpoint: Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 21 Jun-17 11:02 Analysis: Nonparametric-Two Sample Official Results: Yes

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	1	1	0.8	1	1
SED17-08	1	1	1	1	1
SED17-06	1	1	1	0.8	1
SED17-09	0.8	1	1	1	0.8
SED17-13	1	1	1	1	1
SED17-17	1	1	1	0.8	1
SED17-20	0.6	1	0.8	1	0.8
SED17-18	1	1	1	1	0.8
SED17-19	1	1	0.4	0.6	1
SED17-24	1	1	1	1	1
SED17-12	1	1	1	1	0.8
SED17-01	0.8	1	1	1	1
SED17-03	0.8	1	1	1	1
SED17-29	1	1	1	1	1

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	1.345	1.345	1.107	1.345	1.345
SED17-08	1.345	1.345	1.345	1.345	1.345
SED17-06	1.345	1.345	1.345	1.107	1.345
SED17-09	1.107	1.345	1.345	1.345	1.107
SED17-13	1.345	1.345	1.345	1.345	1.345
SED17-17	1.345	1.345	1.345	1.107	1.345
SED17-20	0.8861	1.345	1.107	1.345	1.107
SED17-18	1.345	1.345	1.345	1.345	1.107
SED17-19	1.345	1.345	0.6847	0.8861	1.345
SED17-24	1.345	1.345	1.345	1.345	1.345
SED17-12	1.345	1.345	1.345	1.345	1.107
SED17-01	1.107	1.345	1.345	1.345	1.345
SED17-03	1.107	1.345	1.345	1.345	1.345
SED17-29	1.345	1.345	1.345	1.345	1.345

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	5/5	5/5	4/5	5/5	5/5
SED17-08	5/5	5/5	5/5	5/5	5/5
SED17-06	5/5	5/5	5/5	4/5	5/5
SED17-09	4/5	5/5	5/5	5/5	4/5
SED17-13	5/5	5/5	5/5	5/5	5/5
SED17-17	5/5	5/5	5/5	4/5	5/5
SED17-20	3/5	5/5	4/5	5/5	4/5
SED17-18	5/5	5/5	5/5	5/5	4/5
SED17-19	5/5	5/5	2/5	3/5	5/5
SED17-24	5/5	5/5	5/5	5/5	5/5
SED17-12	5/5	5/5	5/5	5/5	4/5
SED17-01	4/5	5/5	5/5	5/5	5/5
SED17-03	4/5	5/5	5/5	5/5	5/5
SED17-29	5/5	5/5	5/5	5/5	5/5

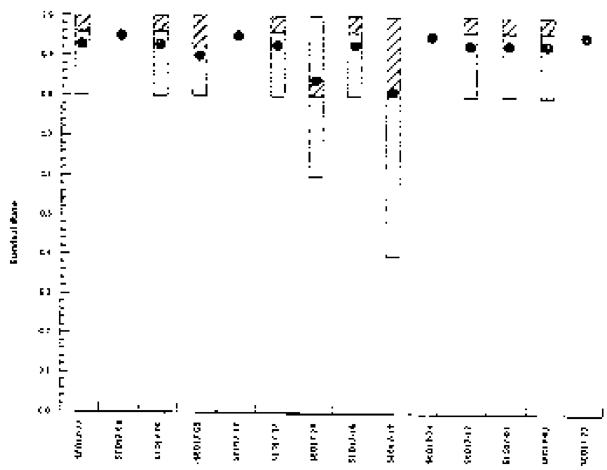
CETIS Analytical Report

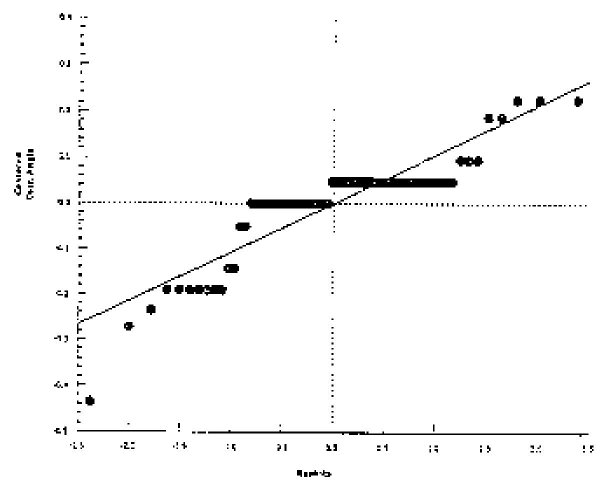
				Report Date:	21 Jun-17 11:32 (p 4 of 4)
				Test Code:	170471c | 11-9348-3710

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	01-3248-6546	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:02	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Graphics





Analyst: JW QA: JW Jul 24/17

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	01-0017-4572	**Endpoint:**	Total Dry Weight	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes
Batch ID:	09-2852-2152	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-27	15-8574-8665	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-27	Sediment Sample	Golder	SED17-27		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	23.3%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-27		SED17-08	1.295	1.86	13.44	8	0.1157	CDF	Non-Significant Effect
		SED17-06	0.8313	1.86	12.03	8	0.2150	CDF	Non-Significant Effect
		SED17-09	2.109	1.86	13.76	8	0.0340	CDF	Significant Effect
		SED17-13	1.145	1.86	12.26	8	0.1427	CDF	Non-Significant Effect
		SED17-17	0.3768	1.86	14.45	8	0.3581	CDF	Non-Significant Effect
		SED17-20	1.899	1.86	14.26	8	0.0471	CDF	Significant Effect
		SED17-18	2.365	1.86	11.31	8	0.0228	CDF	Significant Effect
		SED17-19	2.441	1.86	15.93	8	0.0203	CDF	Significant Effect
		SED17-24	0.7852	1.86	12.12	8	0.2275	CDF	Non-Significant Effect
		SED17-12	2.341	1.86	11.5	8	0.0237	CDF	Significant Effect
		SED17-01	1.25	1.86	11.77	8	0.1234	CDF	Non-Significant Effect
		SED17-03	1.664	1.86	12.77	8	0.0673	CDF	Non-Significant Effect
		SED17-29	1.654	1.86	12.45	8	0.0684	CDF	Non-Significant Effect

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	01-0017-4572	**Endpoint:**	Total Dry Weight	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2099.04	161.4646	13	2.197	0.0216	Significant Effect
Error	4114.933	73.48094	56			
Total	6213.974		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	19.54	27.69	0.1074	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9713	0.9626	0.1078	Normal Distribution

Total Dry Weight Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-27	5	53.41	36.81	70.01	57.41	30.05	64.16	5.979	25.03%	0.0%
SED17-08	5	44.05	32.77	55.33	42.99	32.26	53.26	4.062	20.62%	17.53%
SED17-06	5	48.03	41.16	54.91	46.86	41.52	56.63	2.477	11.53%	10.07%
SED17-09	5	37.8	25.7	49.91	38.08	26.52	49.35	4.36	25.79%	29.22%
SED17-13	5	45.87	38.17	53.56	49.61	37.63	51.27	2.772	13.51%	14.13%
SED17-17	5	50.49	36.7	64.27	50.49	34.17	65.46	4.964	21.99%	5.48%
SED17-20	5	38.85	25.51	52.19	42.9	21.52	48.98	4.803	27.64%	27.27%
SED17-18	5	39.03	35.93	42.13	39.23	35.19	41.39	1.117	6.4%	26.93%
SED17-19	5	32.51	15.47	49.54	31.67	12.68	47.04	6.135	42.2%	39.14%
SED17-24	5	48.3	41.09	55.5	46.31	40.71	55.19	2.595	12.02%	9.58%
SED17-12	5	38.93	34.51	43.34	41.05	34.6	41.94	1.59	9.13%	27.12%
SED17-01	5	45.51	39.75	51.27	45.76	39.24	51.6	2.075	10.2%	14.81%
SED17-03	5	41.98	32.6	51.37	37.98	35.81	53.5	3.38	18.0%	21.4%
SED17-29	5	42.34	33.98	50.7	41.92	35.58	51.7	3.012	15.91%	20.73%

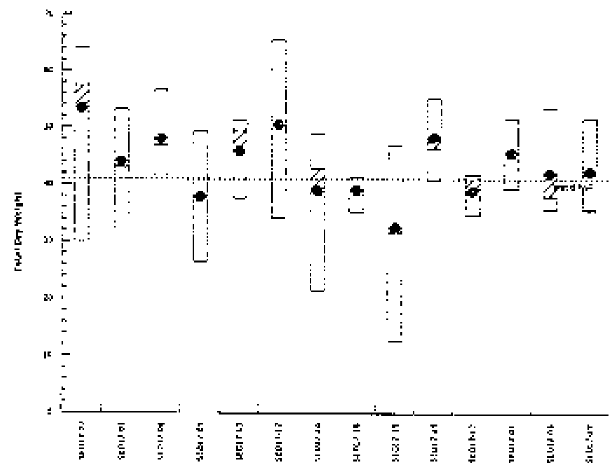
Total Dry Weight Detail

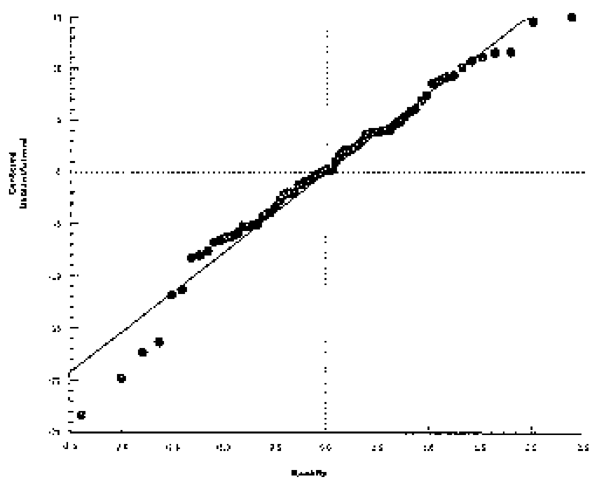
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	57.41	58.23	30.05	64.16	57.22
SED17-08	52.89	42.99	53.26	38.86	32.26
SED17-06	41.52	56.63	46.07	49.09	46.86
SED17-09	26.52	38.08	49.35	45.26	29.81
SED17-13	37.63	40.82	51.27	49.61	50.01
SED17-17	52.04	65.46	50.49	34.17	50.27
SED17-20	21.52	48.98	42.9	44.73	36.12
SED17-18	41.39	38.29	35.19	39.23	41.04
SED17-19	31.67	47.04	12.68	27.54	43.6
SED17-24	40.71	46.31	55.19	52.96	46.31
SED17-12	41.05	41.52	34.6	35.53	41.94
SED17-01	45.76	47.66	51.6	43.27	39.24
SED17-03	35.81	37.98	53.5	45.83	36.79
SED17-29	35.58	46.03	36.48	51.7	41.92

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	01-0017-4572	**Endpoint:**	Total Dry Weight	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:57	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Report Date:	21 Jun-17 11:33 (p 1 of 3)
Test Code:	170471c | 11-9348-3710

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	04-9870-3698	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:03	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Batch ID:	09-2852-2152	**Test Type:**	Survival-Growth	**Analyst:**	Jeslin Wijaya
Start Date:	26 May-17	**Protocol:**	PSEP (1995)	**Diluent:**	Natural seawater
Ending Date:	15 Jun-17	**Species:**	Neanthes arenaceodentata	**Brine:**	
Duration:	20d 0h	**Source:**	Aquatic Toxicology Support, WA	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5643	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-27	Sediment Sample	Golder	SED17-27		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	18.4%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-27		SED17-08	1.787	1.86	2.261	8	0.0559	CDF	Non-Significant Effect
		SED17-06	0.7604	1.86	2.166	8	0.2344	CDF	Non-Significant Effect
		SED17-09	2.654	1.86	2.003	8	0.0145	CDF	Significant Effect
		SED17-13	1.706	1.86	1.973	8	0.0632	CDF	Non-Significant Effect
		SED17-17	0.4663	1.86	2.171	8	0.3267	CDF	Non-Significant Effect
		SED17-20	1.716	1.86	2.004	8	0.0622	CDF	Non-Significant Effect
		SED17-18	2.616	1.86	1.967	8	0.0154	CDF	Significant Effect
		SED17-19	2.63	1.86	2.112	8	0.0151	CDF	Significant Effect
		SED17-24	1.27	1.86	1.939	8	0.1200	CDF	Non-Significant Effect
		SED17-12	2.514	1.86	2.055	8	0.0181	CDF	Significant Effect
		SED17-01	1.294	1.86	2.047	8	0.1158	CDF	Non-Significant Effect
		SED17-03	2.05	1.86	2.022	8	0.0373	CDF	Significant Effect
		SED17-29	2.314	1.86	2.021	8	0.0247	CDF	Significant Effect

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	04-9870-3698	Endpoint:	Mean Dry Weight-mg	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:03	Analysis:	Parametric-Two Sample	Official Results:	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	56.08031	4.31387	13	1.974	0.0406	Significant Effect
Error	122.3938	2.185603	56			
Total	178.4741		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	2.599	27.69	0.9990	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9792	0.9526	0.2955	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-27	5	10.98	8.472	13.49	11.48	7.512	12.83	0.9046	18.42%	0.0%
SED17-08	5	8.81	6.555	11.07	8.598	6.452	10.65	0.8124	20.62%	19.78%
SED17-06	5	10.1	8.061	12.13	9.372	8.304	12.27	0.7336	16.25%	8.06%
SED17-09	5	8.124	6.499	9.749	7.616	6.63	9.87	0.5853	16.11%	26.03%
SED17-13	5	9.174	7.634	10.71	9.922	7.526	10.25	0.5544	13.51%	16.48%
SED17-17	5	10.44	8.389	12.49	10.1	8.542	13.09	0.7383	15.81%	4.96%
SED17-20	5	9.134	7.508	10.76	9.03	7.173	10.72	0.5857	14.34%	16.84%
SED17-18	5	8.216	6.693	9.739	7.846	7.038	10.26	0.5485	14.93%	25.2%
SED17-19	5	7.996	6.091	9.902	8.72	6.334	9.408	0.6865	19.2%	27.19%
SED17-24	5	9.659	8.218	11.1	9.262	8.142	11.04	0.5191	12.02%	12.06%
SED17-12	5	8.205	6.442	9.968	8.21	6.92	10.49	0.6351	17.31%	25.3%
SED17-01	5	9.559	7.818	11.3	9.532	7.848	11.44	0.6271	14.67%	12.97%
SED17-03	5	8.755	7.079	10.43	8.952	7.358	10.7	0.6036	15.42%	20.29%
SED17-29	5	8.468	6.796	10.14	8.384	7.116	10.34	0.6024	15.91%	22.9%

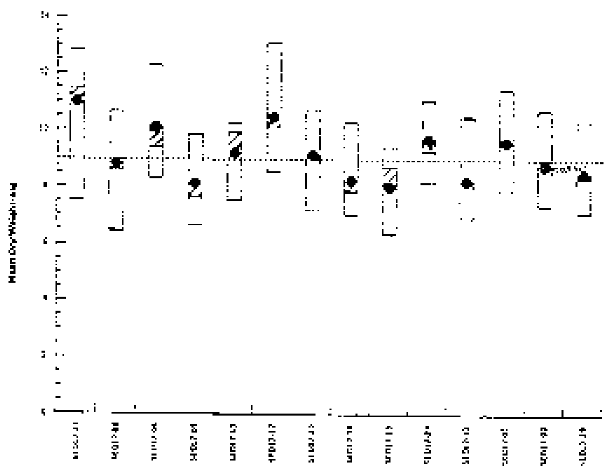
Mean Dry Weight-mg Detail

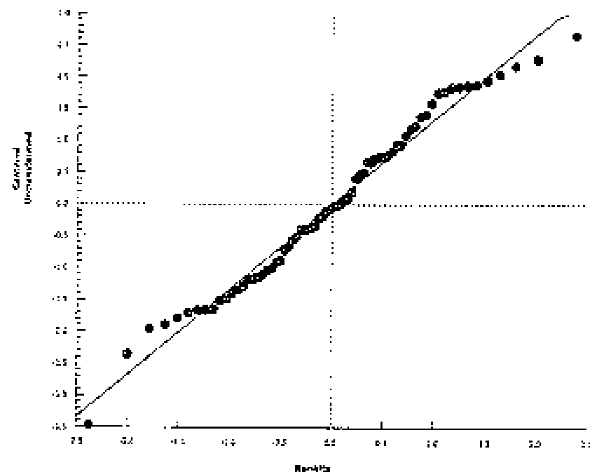
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	11.48	11.65	7.512	12.83	11.44
SED17-08	10.58	8.598	10.65	7.772	6.452
SED17-06	8.304	11.33	9.214	12.27	9.372
SED17-09	6.63	7.616	9.87	9.052	7.452
SED17-13	7.526	8.184	10.25	9.922	10
SED17-17	10.41	13.09	10.1	8.542	10.05
SED17-20	7.173	9.796	10.72	8.946	9.03
SED17-18	8.278	7.658	7.038	7.846	10.26
SED17-19	6.334	9.408	6.34	9.18	8.72
SED17-24	8.142	9.262	11.04	10.59	9.262
SED17-12	8.21	8.304	6.92	7.106	10.49
SED17-01	11.44	9.532	10.32	8.654	7.848
SED17-03	8.952	7.596	10.7	9.166	7.358
SED17-29	7.116	9.206	7.296	10.34	8.384

Neanthes 20-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	04-9870-3698	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:03	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	09-4762-2585	Endpoint:	Individual Growth Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:03	Analysis:	Parametric-Two Sample	Official Results:	Yes
Batch ID:	09-2852-2152	Test Type:	Survival-Growth	Analyst:	Jeslin Wijaya
Start Date:	26 May-17	Protocol:	PSEP (1995)	Diluent:	Natural seawater
Ending Date:	15 Jun-17	Species:	Neanthes arenaceodentata	Brine:	
Duration:	20d 0h	Source:	Aquatic Toxicology Support, WA	Age:	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
SED17-27	15-8574-8565	05 May-17 17:00	15 May-17 10:30	20d 7h (5.5 °C)	Golder	
SED17-08	10-1003-8381	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-06	19-4215-8235	26 Apr-17 17:00	15 May-17 10:30	29d 7h (7.5 °C)		
SED17-09	13-9590-2568	29 Apr-17 17:00	15 May-17 10:30	26d 7h (8.5 °C)		
SED17-13	02-1258-2667	29 Apr-17 17:00	15 May-17 10:30	26d 7h (7.5 °C)		
SED17-17	06-5820-5843	30 Apr-17 17:00	15 May-17 10:30	25d 7h (7 °C)		
SED17-20	00-0790-7357	01 May-17 17:00	15 May-17 10:30	24d 7h (7 °C)		
SED17-18	04-2524-4947	02 May-17 17:00	15 May-17 10:30	23d 7h (4 °C)		
SED17-19	07-6812-4215	02 May-17 17:00	15 May-17 10:30	23d 7h (5.5 °C)		
SED17-24	05-6632-5205	02 May-17 17:00	15 May-17 10:30	23d 7h (6 °C)		
SED17-12	01-4413-4098	04 May-17 17:00	15 May-17 10:30	21d 7h (5 °C)		
SED17-01	05-6502-2240	04 May-17 17:00	15 May-17 10:30	21d 7h (5.8 °C)		
SED17-03	05-1816-3513	04 May-17 17:00	15 May-17 10:30	21d 7h (7.2 °C)		
SED17-29	08-4658-3752	04 May-17 17:00	15 May-17 10:30	21d 7h (8.5 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
SED17-27	Sediment Sample	Golder	SED17-27		
SED17-08	Sediment Sample	Golder	SED17-08		
SED17-06	Sediment Sample	Golder	SED17-06		
SED17-09	Sediment Sample	Golder	SED17-09		
SED17-13	Sediment Sample	Golder	SED17-13		
SED17-17	Sediment Sample	Golder	SED17-17		
SED17-20	Sediment Sample	Golder	SED17-20		
SED17-18	Sediment Sample	Golder	SED17-18		
SED17-19	Sediment Sample	Golder	SED17-19		
SED17-24	Sediment Sample	Golder	SED17-24		
SED17-12	Sediment Sample	Golder	SED17-12		
SED17-01	Sediment Sample	Golder	SED17-01		
SED17-03	Sediment Sample	Golder	SED17-03		
SED17-29	Sediment Sample	Golder	SED17-29		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	19.3%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
SED17-27		SED17-08	1.787	1.86	0.113	8	0.0559	CDF	Non-Significant Effect
		SED17-06	0.7604	1.86	0.108	8	0.2344	CDF	Non-Significant Effect
		SED17-09	2.654	1.86	0.100	8	0.0145	CDF	Significant Effect
		SED17-13	1.706	1.86	0.099	8	0.0632	CDF	Non-Significant Effect
		SED17-17	0.4663	1.86	0.109	8	0.3267	CDF	Non-Significant Effect
		SED17-20	1.716	1.86	0.100	8	0.0622	CDF	Non-Significant Effect
		SED17-18	2.616	1.86	0.098	8	0.0154	CDF	Significant Effect
		SED17-19	2.63	1.86	0.106	8	0.0151	CDF	Significant Effect
		SED17-24	1.27	1.86	0.097	8	0.1200	CDF	Non-Significant Effect
		SED17-12	2.514	1.86	0.103	8	0.0181	CDF	Significant Effect
		SED17-01	1.294	1.86	0.102	8	0.1158	CDF	Non-Significant Effect
		SED17-03	2.05	1.86	0.101	8	0.0373	CDF	Significant Effect
		SED17-29	2.314	1.86	0.101	8	0.0247	CDF	Significant Effect

Analyst: JW QA: July 24/17

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	09-4762-2585	Endpoint:	Individual Growth Rate	CETIS Version:	CETISv1.8.7
Analyzed:	21 Jun-17 11:03	Analysis:	Parametric-Two Sample	Official Results:	Yes

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.1402008	0.01078467	13	1.974	0.0406	Significant Effect
Error	0.3059843	0.005464006	56			
Total	0.4461851		69			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	2.599	27.69	0.9990	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9792	0.9526	0.2955	Normal Distribution

Individual Growth Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
SED17-27	5	0.5234	0.3978	0.649	0.5484	0.3499	0.6159	0.04523	19.32%	0.0%
SED17-08	5	0.4148	0.302	0.5276	0.4041	0.2969	0.5069	0.04062	21.9%	20.76%
SED17-06	5	0.4791	0.3773	0.581	0.4428	0.3894	0.5879	0.03668	17.12%	8.46%
SED17-09	5	0.3805	0.2992	0.4617	0.3551	0.3057	0.4677	0.02926	17.2%	27.31%
SED17-13	5	0.4329	0.356	0.5099	0.4703	0.3506	0.487	0.02772	14.32%	17.29%
SED17-17	5	0.4962	0.3937	0.5987	0.4791	0.4014	0.6288	0.03691	16.63%	5.2%
SED17-20	5	0.431	0.3497	0.5123	0.4257	0.3329	0.5105	0.02928	15.19%	17.67%
SED17-18	5	0.3851	0.3089	0.4612	0.3665	0.3262	0.4873	0.02743	15.93%	26.44%
SED17-19	5	0.3741	0.2788	0.4694	0.4102	0.291	0.4447	0.03432	20.52%	28.53%
SED17-24	5	0.4572	0.3852	0.5293	0.4374	0.3813	0.5262	0.02595	12.69%	12.65%
SED17-12	5	0.3845	0.2963	0.4727	0.3848	0.3203	0.4985	0.03176	18.47%	26.54%
SED17-01	5	0.4522	0.3651	0.5392	0.4508	0.3666	0.5463	0.03135	15.5%	13.61%
SED17-03	5	0.412	0.3282	0.4958	0.4219	0.3421	0.5092	0.03018	16.38%	21.29%
SED17-29	5	0.3977	0.314	0.4813	0.3934	0.3301	0.4912	0.03012	16.94%	24.02%

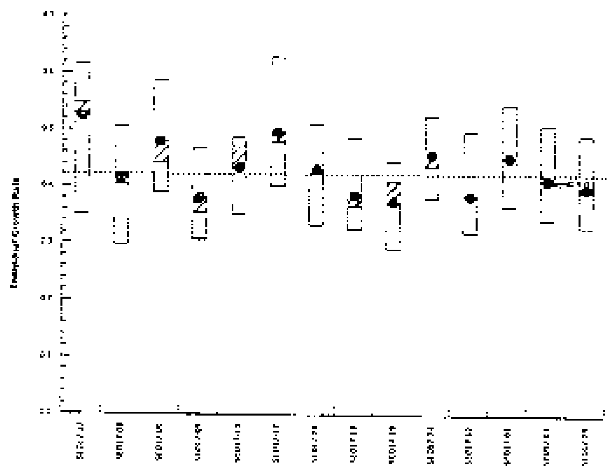
Individual Growth Rate Detail

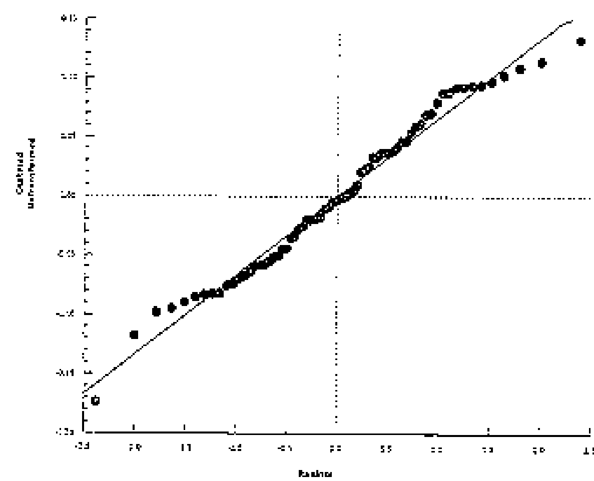
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
SED17-27	0.5484	0.5565	0.3499	0.6159	0.5464
SED17-08	0.5032	0.4041	0.5069	0.3629	0.2969
SED17-06	0.3894	0.5406	0.4349	0.5879	0.4428
SED17-09	0.3057	0.3551	0.4677	0.4269	0.3469
SED17-13	0.3506	0.3825	0.487	0.4703	0.4743
SED17-17	0.4946	0.6288	0.4791	0.4014	0.477
SED17-20	0.3329	0.464	0.5105	0.4215	0.4257
SED17-18	0.3881	0.3572	0.3262	0.3665	0.4873
SED17-19	0.291	0.4447	0.2913	0.4333	0.4102
SED17-24	0.3813	0.4374	0.5262	0.5038	0.4373
SED17-12	0.3848	0.3895	0.3203	0.3296	0.4985
SED17-01	0.5463	0.4508	0.4902	0.407	0.3666
SED17-03	0.4219	0.3541	0.5092	0.4326	0.3421
SED17-29	0.3301	0.4346	0.339	0.4912	0.3934

Neanthes 20-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	09-4762-2585	**Endpoint:**	Individual Growth Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	21 Jun-17 11:03	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





NAUTILUS ENVIRONMENTAL
ATTN: Jeslin Wijaya
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 26-MAY-17
Report Date: 05-JUN-17 15:08 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L1932455

Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: OL-2454
Legal Site Desc:

Heather McKenzie
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932455-1	L1932455-2	L1932455-3	L1932455-4	L1932455-5
	Description	Overlying Water	Overlying Water	Overlying Water	Overlying Water	Overlying Water
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	CONTROL SEDIMENT - OVERLYING	SED 17-12 - OVERLYING	SED 17-13 - OVERLYING	SED 17-06-OVERLYING	SED 17-08-OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0282	0.377	0.120	0.773	0.747
	Sulphide as S (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L1932455-6	L1932455-7	L1932455-8	L1932455-9	L1932455-10
	Sample ID	L1932455-6	L1932455-7	L1932455-8	L1932455-9	L1932455-10
	Description	Overlying Water	Overlying Water	Overlying Water	Overlying Water	Overlying Water
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-09-OVERLYING	SED-17-17 - OVERLYING	SED 17-18-OVERLYING	SED 17-01 - OVERLYING	SED 17-03 - OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.219	0.545	0.446	0.421	1.48
	Sulphide as S (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932455-11	L1932455-12	L1932455-13	L1932455-14	L1932455-15
	Description	Overlying Water	Overlying Water	Overlying Water	Overlying Water	Overlying Water
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-19 - OVERLYING	SED 17-20 - OVERLYING	SED 17-24 - OVERLYING	SED 17-27 - OVERLYING	SED 17-29 - OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.477	0.295	0.497	0.271	0.581
	Sulphide as S (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932455-16	L1932455-17	L1932455-18	L1932455-19	L1932455-20
	Description	Porewater	Porewater	Porewater	Porewater	Porewater
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	CONTROL SEDIMENT - INTERSTITIAL	SED 17-12 - INTERSTITIAL	SED 17-13 - INTERSTITIAL	SED 17-06 - INTERSTITIAL	SED 17-08 - INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	2.93	1.25	1.12	2.69	9.18
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	0.018	37.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932455-21	L1932455-22	L1932455-23	L1932455-24	L1932455-25
	Description	Porewater	Porewater	Porewater	Porewater	Porewater
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED17-09 - INTERSTITIAL	SED17-17 - INTERSTITIAL	SED17-18 - INTERSTITIAL	SED17-01 - INTERSTITIAL	SED 17-03 - INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	1.09	4.01	2.44	2.26	4.83
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932455-26	L1932455-27	L1932455-28	L1932455-29	L1932455-30
	Description	Porewater	Porewater	Porewater	Porewater	Porewater
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-19 - INTERSTITIAL	SED 17-20 - INTERSTITIAL	SED 17-24 - INTERSTITIAL	SED 17-27 - INTERSTITIAL	SED 17-29 - INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	3.43	2.04	2.42	0.885	2.74
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	<0.018

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Sulphide as S	MS-B	L1932455-16, -17, -18, -19, -20, -21, -22, -23, -24, -25, -26, -27, -28, -29, -30

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

ALS Test Code	Matrix	Test Description	Method Reference**
S2-T-COL-VA	Water	Total Sulphide by Colorimetric	APHA 4500-S2 Sulphide

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

OL-2454

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free : 1 800 668 9878
www.alsglobal.com

Report To		Reporting		Service Requested
Company:	Nautilus Environmental	Distribution: ☐Fax ☐Mail ☑Email		⊙ Regular (Standard Turnaround Times - Business Days) - R
Contact:	Jeslin Wijaya	☐Criteria on Report (select from Guidelines below)		○ Priority (3 Days) - surcharge will apply - P
Address:	8664 Commerce Court Imperial Square Lake City Burnaby, BC Canada, V5A 4N7	Report Type: ☐Excel ☑Digital		○ Priority (2 Days) - surcharge will apply - P2
		Report Format:		○ Emergency (1-2 day) – surcharge will apply - E
		Report Email(s):	jeslin@nautilusenvironmental.ca	○ Same Day or Weekend Emergency - surcharge will apply - E2
				○ Specify date required - X
Phone: 604-420-8773	Fax: 604-357-1361			Analysis Requests
Invoice To ☑Email	☐Mail	EDD Format:		
Company:	Nautilus Environmental	EDD Email(s):		
Contact:	Jeslin Wijaya			
Address:	8664 Commerce Court Imperial Square Lake City Burnaby, BC Canada, V5A 4N7	Project Info		
		Job #:		
		PO/AFE:		
Email:	jeslin@nautilusenvironmental.ca	LSD:		
Phone:	604-420-8773	Quote #:		
Lab Work Order # (lab use only)		ALS Contact	Sampler:	

L1932455-COFC

Sample #	Sample Identification (This will appear on the report)	Coordinates Longitude	Coordinates Latitude	Date	Time	Sample Type	Number of Containers	Ammonia	Sulfide	Sulfide
							Please indicate below Filtered, P ... F/P)	P	P	P
	Control Sediment - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-12 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-13 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-06- Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-08- Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-09- Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-17 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-18- Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		

(See page 2 for further samples)

Special Instructions/Comments

The questions below must be answered for water samples (check Yes or No)

Are any sample taken from a regulated DW system? ☐Yes ☐No

If yes, please use an authorized drinking water COC

Is the water sampled intended to be potable for human consumption? ☐Yes ☐No

Guidelines

SAMPLE CONDITION (lab use only)

☐Frozen ☐Cold ☐Ambient ☐Cooling Initiated

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Jeslin Wijaya Nautilus Environmental	Date: May 26/19	Time: 15:00	Received by: PAUL	Date: MAY 26	Time: 19:00	Temperature: 18.5 °C	Verified by:	Date:	Time:	Observations: ☐Yes If Yes add SIF

COC #: OL-2454

Chain of Custody / Analytical Request Form
Canada Toll Free : 1 800 668 9878
www.alsglobal.com

ALS Environmental

Sample #	Sample Identification (This will appear on the report)	Coordinates: Longitude	Coordinates: Latitude	Date	Time	Sample Type	Number of Containers	Ammonia	Sulfide	Sulfide
								Please indicate below Filtered, Preserved or both(F, P, F/P)		
								P	P	P
	SED 17-01 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-03 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-19 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-20 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-24 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-27 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	SED 17-29 - Overlying			May-26-2017	09:00 AM	Overlying Water	1	R		
	Control Sediment - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-12 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R		R
	SED 17-13 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED17-06 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-08 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED17-09 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED17-17 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED17-18 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED17-01 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-03 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-19 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-20 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-24 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-27 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	
	SED 17-29 - Interstitial			May-26-2017	09:00 AM	Porewater	2	R	R	

L1932455-COFC

NAUTILUS ENVIRONMENTAL
ATTN: Jeslin Wijaya
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 19-JUN-17
Report Date: 27-JUN-17 17:46 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L1944530

Project P.O. #: NOT SUBMITTED

Job Reference:

C of C Numbers: OL-2524

Legal Site Desc:

Heather McKenzie
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1944530-1	L1944530-2	L1944530-3	L1944530-4	L1944530-5
	Description	Overlying Water	Overlying Water	Overlying Water	Overlying Water	Overlying Water
	Sampled Date	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	CONTROL SEDIMENT - OVERLYING	SED 17-08 - OVERLYING	SED 17-06 - OVERLYING	SED 17-09 - OVERLYING	SED 17-13 - OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	3.16	1.18	5.37	3.58	2.19
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1944530-6	L1944530-7	L1944530-8	L1944530-9	L1944530-10
	Description	Overlying Water	Overlying Water	Overlying Water	Overlying Water	Overlying Water
	Sampled Date	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-17 - OVERLYING	SED 17-20 - OVERLYING	SED 17-18 - OVERLYING	SED 17-19 - OVERLYING	SED 17-24 - OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	2.21	1.01	1.33	1.59	0.568
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1944530-11	L1944530-12	L1944530-13	L1944530-14	L1944530-15
	Description	Overlying Water	Overlying Water	Overlying Water	Overlying Water	Overlying Water
	Sampled Date	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-12 - OVERLYING	SED 17-01 - OVERLYING	SED 17-03 - OVERLYING	SED 17-29 - OVERLYING	SED 17-27 - OVERLYING
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.751	1.85	2.56	3.35	5.23
	Sulphide as S (mg/L)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1944530-16	L1944530-17	L1944530-18	L1944530-19	L1944530-20
	Description	Overlying Water	Porewater	Porewater	Porewater	Porewater
	Sampled Date	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	CONTROL SEDIMENT - INTERSTITIAL	SED 17-08 - INTERSTITIAL	SED 17-06 INTERSTITIAL	SED 17-09 INTERSTITIAL	SED 17-13 INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	1.84	1.11	4.52	4.68	4.15
	Sulphide as S (mg/L)	<0.018	<0.018	<0.018	<0.018	0.032

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1944530-21	L1944530-22	L1944530-23	L1944530-24	L1944530-25
	Description	Porewater	Porewater	Porewater	Porewater	Porewater
	Sampled Date	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-17 INTERSTITIAL	SED 17-20 INTERSTITIAL	SED 17-18 INTERSTITIAL	SED 17-19 INTERSTITIAL	SED 17-24 INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	5.66	5.03	4.79	4.07	5.93
	Sulphide as S (mg/L)	<0.018	<0.018	0.018	<0.018	<0.018

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1944530-26	L1944530-27	L1944530-28	L1944530-29	L1944530-30
	Description	Porewater	Porewater	Porewater	Porewater	Porewater
	Sampled Date	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17	15-JUN-17
	Sampled Time	09:00	09:00	09:00	09:00	09:00
	Client ID	SED 17-12 INTERSTITIAL	SED 17-01 INTERSTITIAL	SED 17-03 INTERSTITIAL	SED 17-29 INTERSTITIAL	SED 17-27 INTERSTITIAL
Grouping	**Analyte**					
WATER						
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	1.67	4.68	8.75	4.67	5.90
	Sulphide as S (mg/L)	<0.018	<0.018	0.021	0.049	<0.018

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
S2-T-COL-VA	Water	Total Sulphide by Colorimetric	APHA 4500-S2 Sulphide
This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

OL-2524

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Ch L1944530-COFC

Report To	
Company:	Nautilus Environmental
Contact:	Jeslin Wijaya
Address:	8664 Commerce Court Imperial Square Lake City Burnaby, BC Canada, V5A 4N7
Phone:	604-420-8773
Fax:	604-357-1361
Invoice To	☑Email ☐Mail
Company:	Nautilus Environmental
Contact:	Joslin Wijaya
Address:	8664 Commerce Court Imperial Square Lake City Burnaby, BC Canada, V5A 4N7
Email:	jeslin@nautilusenvironmental.ca
Phone:	604-420-8773
Lab Work Order # (lab use only)	

Reporting	
Distribution:	☐Fax ☑Mail ☐Email
☐Criteria on Report (select from Guidelines below)	
Report Type:	☐Excel ☐Digital
Report Format:	
Report Email(s):	
EDD Format:	
EDD Email(s):	
Project Info	
Job #:	
PO/AFE:	
LSD:	
Quote #:	
ALS Contact:	Sampler:

Service Requested

- ⊙ Regular (Standard Turnaround Times - Business Days) - R
- ○ Priority (3 Days) - surcharge will apply - P
- ○ Priority (2 Days) - surcharge will apply - P2
- ○ Emergency (1-2 day) – surcharge will apply - E
- ○ Same Day or Weekend Emergency - surcharge will apply - E2
- ○ Specify date required - X

Analysis Requests

Please indicate below Filtered, Preserved or both(F, P, F/P)

Sample #	Sample Identification (This will appear on the report)	Longitude	Latitude	Date	Time	Sample Type	Number of Containers	Ammonia	Sulfide	Sulfide
								P	P	P
[redacted]	Control Sediment - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R		
[redacted]	SED 17-08 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R		
[redacted]	SED 17-06 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R		
[redacted]	SED 17-09 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R		
[redacted]	SED 17-13 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R		
[redacted]	SED 17-17 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R		
[redacted]	SED 17-20 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R		
[redacted]	SED 17-18 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R		
[redacted]	*(See page 2 for further samples)*									

Short Holding Time

Rush Processing

Special Instructions/Comments

The questions below must be answered for water samples (check Yes or No)

Are any samples taken from a regulated DW system? ☐Yes ☐No

If yes, please use an authorized drinking water COC

Is the water sampled intended to be potable for human consumption? ☐Yes ☐No

Guidelines

SAMPLE CONDITION (lab use only)

☐Frozen ☐Cold ☐Ambient ☐Cooling Initiated

SHIPMENT RELEASE (client use)		
Released by:	Date:	Time:
Jeslin W. - Nautilus Environmental	Jun 15/17	16:00

SHIPMENT RECEPTION (lab use only)			
Received by:	Date:	Time:	Temperature:
Trevor	June 19	16:45	5 °C

SHIPMENT VERIFICATION (lab use only)			
Verified by:	Date:	Time:	Observations: ☐Yes If Yes add SIF

ALS Environmental

Analysis Requests — Please indicate below Filtered, Preserved or both(F, P, F/P)

Sample #	Sample Identification (This will appear on the report)	Coordinates: Longitude	Coordinates: Latitude	Date	Time	Sample Type	Number of Containers	Ammonia	Sulfide	Sulfide																
								P	P	P																
	SED 17-19 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R																		
	SED 17-24 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R																		
	SED 17-12 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R																		
	SED 17-01 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R																		
	SED 17-03 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R																		
	SED 17-29 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R																		
	SED 17-27 - Overlying			Jun-15-2017	09:00 AM	Overlying Water	1	R																		
	Control Sediment - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-08 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-06 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R		R																
	SED 17-09 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-13 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-17 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-20 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-18 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-19 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-24 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-12 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-01 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-03 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-29 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	
	SED 17-27 - Interstitial			Jun-15-2017	09:00 AM	Porewater	2	R	R																	

APPENDIX F

Quality Assurance/Quality Control Results

APPENDIX F
QA/QC Table of Collected Surficial Sediment

Sample Name / Sample Date / Laboratory Sample ID	SED17-12 04/05/2017 K1704542	DUP-3 04/05/2017 K1704542	Method Detection Limit	Relative Percent Difference (%)	SED17-18 02/05/2017 K1704471	DUP-2 02/05/2017 K1704471	Method Detection Limit	Relative Percent Difference (%)	SED17-31 28/04/2017 K1704415	DUP-1 28/04/2017 K1704415	Method Detection Limit	Relative Percent Difference (%)
Physical Parameters (%)												
Percent Solids	76	77		1.2	66	63		3.9	48	49		2.7
Metals (mg/kg dry wt)												
Aluminum (Al)	7880	8420	1.7	6.6	13300	13400	1.7	0.75	20500	19900	1.7	3.0
Antimony (Sb)	0.21	0.15	0.043	-	0.066	0.079	0.043	-	< 0.068	< 0.068	0.068	-
Arsenic (As)	3.8	2.6	0.43	**37**	3.4	3.3	0.43	3.3	5.7	5.8	0.43	2.8
Barium (Ba)	174	166	0.68	4.7	295	299	0.68	1.3	450	439	0.68	2.5
Beryllium (Be)	0.14	0.17	0.017	23	0.28	0.24	0.017	12	0.42	0.36	0.017	15
Cadmium (Cd)	1.2	1.3	0.017	4.8	0.61	0.6	0.017	1.6	0.56	0.72	0.017	25
Calcium (Ca)	14300	6750	3.4	**72**	9640	15400	3.4	**46**	12200	13800	3.4	12
Chromium (Cr)	19	12	0.17	**49**	17	16	0.17	8.0	25	22	0.17	11
Cobalt (Co)	6.9	5.5	0.017	23	8.0	7.3	0.017	9.8	12	11	0.017	10.0
Copper (Cu)	96	89	0.085	7.9	46	38	0.085	19	19	18	0.085	7.7
Iron (Fe)	40600	17000	3.4	**82**	24700	24600	3.4	0.41	37800	37500	3.4	0.8
Lead (Pb)	469	534	0.043	13	119	112	0.043	6.1	17	16	0.043	4.8
Magnesium (Mg)	5570	5570	1.7	0	8390	8480	1.7	1.1	13200	13200	1.7	0
Manganese (Mn)	370	370	0.17	0	329	327	0.17	0.61	492	478	0.17	2.9
Mercury (Hg)	0.53	0.46	0.015	15	0.15	0.17	0.015	12	< 0.021	< 0.021	0.021	-
Nickel (Ni)	15	5.6	0.17	**91**	8.8	8.2	0.17	7.3	13	12	0.17	8.6
Potassium (K)	3730	3440	34	8.1	6220	6240	34	0.32	9550	9370	34	1.9
Selenium (Se)	< 0.99	< 0.99	0.99	-	< 1.2	< 1.2	1.2	-	< 1.3	< 1.3	1.3	-
Silver (Ag)	0.58	0.57	0.017	2.3	0.33	0.33	0.017	0.91	0.26	0.23	0.017	13
Sodium (Na)	4250	3640	34	15	7010	7260	34	3.5	14300	14100	34	1.4
Thallium (Tl)	0.2	0.22	0.017	10	0.3	0.29	0.017	4.0	0.51	0.51	0.017	0.59
Vanadium (V)	29	36	0.17	20	56	52	0.17	7.6	78	70	0.17	10
Zinc (Zn)	806	776	0.85	3.8	240	240	0.85	0	115	114	0.85	0.87
Polycyclic Aromatic Hydrocarbons (µg/kg dry wt)												
Acenaphthene	< 6.4	770	6.4	-	<5.8	8.9	5.8	-	<5.8	<5.8	5.8	-
2-methylnaphthalene	< 6.4	220	6.4	-	15	17	5.8	-	<5.8	<5.8	5.8	-
Acenaphthylene	21	110	6.4	**136**	7.9	11	5.8	-	<5.8	<5.8	5.8	-
Anthracene	56	1400	6.4	**185**	70	76	5.8	8.2	<5.8	11	5.8	-
Benzo(a)anthracene	220	3400	6.4	**176**	260	390	5.8	**40**	20	37	5.8	**60**
Benzo(a)pyrene	130	2400	6.4	**179**	140	170	5.8	19	<5.8	23	5.8	-
Benzo(b)fluoranthene	270	3600	6.4	**172**	330	400	5.8	19	28	37	5.8	28
Benzo(g,h,i)perylene	39	1200	6.4	**187**	49	59	5.8	19	<5.8	14	5.8	-
Benzo(k)fluoranthene	97	1100	6.4	**168**	120	160	5.8	29	<5.8	16	5.8	-
Chrysene	280	3300	6.4	**169**	290	400	5.8	**32**	<5.8	37	5.8	-
Dibenzo(a,h)anthracene	12	340	6.4	**186**	16	23	5.8	-	<5.8	<5.8	5.8	-
Dibenzofuran	< 6.4	710	6.4	-	13	22	5.8	-	<5.8	<5.8	5.8	-
Fluoranthene	370	8900	6.4	**184**	800	1000	5.8	22	49	58	5.8	17
Fluorene	13	1200	6.4	**196**	29	52	5.8	**57**	<5.8	<5.8	5.8	-
Indeno(1,2,3-c,d)pyrene	47	1300	6.4	**186**	62	77	5.8	22	<5.8	<5.8	5.8	-
Naphthalene	< 6.4	460	6.4	-	<5.8	<5.8	5.8	-	<5.8	<5.8	5.8	-
Phenanthrene	95	7000	6.4	**195**	190	380	5.8	**67**	<5.8	12	5.8	-
Pyrene	330	5800	6.4	**178**	560	690	5.8	21	60	78	5.8	26

Notes

% = percent; dry wt = dry weight; mg/kg = milligrams per kilogram; µg/kg = micrograms per kilogram.

RPD = Relative Percent Difference = absolute value[100% x (sample - duplicate)/(sample + duplicate)/2].

'-' Indicates RPD not calculable because one or more value was less than five times the method detection limit.

Value Indicates the RPD was greater than 30%

O:\Final\2016\3 Proj\1657231 WPYR_Ore Basin Sediment_Alaska\1657231-004-R-Rev0\APP\APP F - QAQC Results\
APP F_QAQC.xlsx
Field QAQC

APPENDIX G

ADEC Checklist

Laboratory Data Review Checklist

Completed by:

Paddy McManus

Title:

Scientist

Date:

July 05, 2017

CS Report Name:

2017 Skagway Inner Harbour Sediment Sampling Program

Report Date:

August 04, 2020

Consultant Firm:

Golder Associates Ltd.

Laboratory Name:

ALS Environmental

Laboratory Report Number:

K1704543, K1704542, K1704473, K1704471, K1704419, K1704415, K1704246/7 (sediment) K1704545 (tissue)

ADEC File Number:

1526.38.004

Hazard Identification Number:

401

1. Laboratory

   a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

      ◉ Yes ○ No Comments:

      Yes

   b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

      ○ Yes ○ No Comments:

      N/A - Samples were not transferred to another laboratory

2. Chain of Custody (COC)

   a. COC information completed, signed, and dated (including released/received by)?

      ◉ Yes ○ No Comments:

      Initial shipment reception signed for all COCs

   b. Correct analyses requested?

      ◉ Yes ○ No Comments:

      Yes

3. Laboratory Sample Receipt Documentation

   a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

      ○ Yes ◉ No Comments:

      Samples/ cooler temperatures were within excepted range except at:
      K1704543 - internal temperature of 1/2 coolers was -2.2◦C
      K1704542 - internal temperature of 1/2 coolers was -2.2◦C
      K1704545 - internal temperature of 1/2 coolers was -2.2◦C

   b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

      ◉ Yes ○ No Comments:

      Submitted sediment samples contained no head space. Equipment blank dionized water rinsate samples were preserved according to laboratory instructions - water samples were properly preserved in the field with HCL (DRO) and Nitric Acid (dissolved metals) upon laboratory submissions

   c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

      Samples arrived at the laboratory unbroken and in good condition, tissue samples arrive at the laboratory frozen

◉ Yes ◯ No Comments:

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

◉ Yes ◯ No Comments:

Sediment samples were refrigerated at 4C prior to being packed along with icepacks into coolers and submitted to the analyzing laboratory. Sediment samples were confirmed as unfrozen and tissue samples were confirmed as frozen prior to shipment.

e. Data quality or usability affected?

Comments:

No, though the internal temperature of the cooler was below freezing the analyzing lab did not report that samples were outside of DQOs.

4. Case Narrative

a. Present and understandable?

◉ Yes ◯ No Comments:

Yes

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ◯ No Comments:

Please see the attached table for a summary of the items presented in the case narrative, the corrective actions undertaken by the analysing lab and the effects on data quality/useability documented for each item.

c. Were all corrective actions documented?

◉ Yes ◯ No Comments:

Yes - refer to the corresponding sections appended to this document in the case narrative summary.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Refer to the corresponding sections appended to this document in the case narrative summary.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ◯ No Comments:

Yes

b. All applicable holding times met?

Yes.

☒ Yes ☐ No Comments:

c. All soils reported on a dry weight basis?

☒ Yes ☐ No Comments:

Yes

d. Are the reported LOQs less than the Cleanup Level or the minimum required detection level for the project?

☐ Yes ☒ No Comments:

No.

e. Data quality or usability affected?

Comments:

No.

6. <u>QC Samples</u>

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

☒ Yes ☐ No Comments:

Yes

ii. All method blank results less than limit of quantitation (LOQ)?

☒ Yes ☐ No Comments:

Yes

iii. If above LOQ, what samples are affected?

Comments:

No method blank results above LOQ

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

☒ Yes ☐ No Comments:

N/A- no affected samples

v. Data quality or usability affected?

Comments:

No

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

Yes

☑ Yes ☐ No Comments:

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

☑ Yes ☐ No Comments:

Yes

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

☐ Yes ☑ No Comments:

See appended case narative summary

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/MSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

☑ Yes ☐ No Comments:

See appended case narative summary

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A - no samples affected

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

☐ Yes ☑ No Comments:

N/A - no samples affected

vii. Data quality or usability affected?

Comments:

No - data quality is not affected

c. Surrogates – Organics Only

i. Are surrogate recoveries reported for organic analyses – field, QC and laboratory samples?

☑ Yes ☐ No Comments:

See appended case narative summary

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

☐ Yes ☑ No Comments:

See appended case narative summary

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

☒ Yes ☐ No Comments:

Yes

iv. Data quality or usability affected?

Comments:

Surrogates could not be quantified due to sample maxtrix interferences, follow up with the analyzing lab is underway.

d. Trip blank – Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and cooler?

☐ Yes ☒ No Comments:

One trip blank was analyzed for the project.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

☐ Yes ☐ No Comments:

No

iii. All results less than LOQ?

☐ Yes ☒ No Comments:

Manganese is greater than the LOQ

iv. If above LOQ, what samples are affected?

Comments:

Follow-up with lab in underway, only the water sample matrix is affected so only QA/QC samples are affected.

v. Data quality or usability affected?

Comments:

No - data quality is not affected

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

☒ Yes ☐ No Comments:

Three sediment duplicates were collected

ii. Submitted blind to lab?

◉ Yes ○ No Comments:

Yes

iii. Precision – All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute value of: } \frac{(R_1-R_2)}{((R_1+R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

○ Yes ◉ No Comments:

Duplicate pair SED17-12 and DUP-3 reported the following analytes outside both ADEC (50%) and Golder (30%) DQOs: Calcium (72%), Iron (82%), Nickel (91%), Acenaphthylene (136%), Anthracene (185%), Benzo(a)anthracene (176%), Benzo(a)pyrene (179%)m Benzo(b)fluoranthene (172%), Benzo(g,h,i)perylene (187%), Benzo(k)fluoranthene (168%), Chrysene (169%), Dibenzo(a,h)anthracene (186%), Fluoranthene (184%), Fluorene (196%), Indeno(1,2,3-c,d)pyrene (186%), Phenanthrene (195%) and Pyrene (178%). The duplicate pair also reported Arsenic (37%) and Chromium (49%) that were outside of Golder DQOs.

Duplicate pair SED17-18 and DUP-2 reported the following analytes outside both ADEC and Golder DQOs: Fluorene (57%) and Phenanthrene (67%). The duplicate pair also reported Calcium (46%), Benzo(a)anthracene (40%) and Chrysene (32%) that were outside of Golder DQOs.

Duplicate pair SED17-31 and DUP-1 reported that Benzo(a)anthracene was outside of both ADEC and Golder DQOs (60%).

iv. Data quality or usability affected?

Comments:

The values outside of ADEC and Golder DQOs are not expected to adversely affect the interpretation of the sediment data.

f. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below.)

◉ Yes ○ No ○ Not Applicable

i. All results less than LOQ?

○ Yes ◉ No Comments:

Aluminum, Calcium, Copper, Iron, Lead, Magnesium, Manganese and Sodium were all above the LOQ for the equipment blank.

ii. If above LOQ, what samples are affected?

Comments:

Follow-up with lab in underway, only the water sample matrix is affected so only QA/QC samples are affected.

iii. Data quality or usability affected?

Comments:

The values greater than lab LOQs are not expected to adversely affect the interpretation of the sediment data.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

(●) Yes ( ) No Comments:

Yes

Summary of items presented in the sediment chemistry analysis case narrative by ALS Environmental including the corrective actions and corresponding effects on data quality/usability for each item

K1704545 - tissue

Matrix spike recovery of Iron for sample NF-CRAB-02 was outside control criteria Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. No further corrective action was appropriate.

Matrix spike recovery of Silver for sample REF-CRAB-03 was outside control criteria Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. No further corrective action was appropriate.

K1704545 - water

The matrix spike recovery of Manganese for the Batch QC sample was outside control criteria. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicates the analytical batch was in control. No further corrective action was appropriate.

The matrix spike recovery of Mercury for sample Homog. Blank was outside control criteria. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicates the analytical batch was in control. No further corrective action was appropriate.

Relative Percent Difference (RPD) for the replicate analysis of Calcium and Iron in sample NF-CRAB-02 was outside the Method control limits The variability in the results was attributed to the heterogeneous distribution of Calcium and Iron in the sample. Freeze drying, grinding in combination with standard mixing techniques were used, but were not sufficient for complete homogenization of this sample.

K1704542 - sediment

The control criteria for matrix spike recovery of Aluminum Barium, Iron, and Magnesium for sample SED17-07 were not applicable. The analyte concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

Antimony recoveries are generally low for soil and sediment samples when digested using EPA Method 3050B. Antimony results (in conjunction with the matrix spike recovery) from this procedure should only be used as indicators to estimate concentrations. The associated QA/QC results (e.g., control sample, calibration standards, etc.) indicated the analysis was in control.

The matrix spike recovery of Barium and Lead for sample SED17-07 was outside control criteria. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. No further corrective action was appropriate.

The Relative Percent Difference (RPD) for the replicate analysis of Copper and Nickel in sample SED17-07 was outside the normal ALS control limits. The variability in the results was attributed to the heterogeneous character of the sample. Standard mixing techniques were used, but were not sufficient for complete homogenization of this sample.

The following analytes were flagged as outside the control criterion for Continuing Calibration Verification (CCV) MS11\0515F002.D and MS11\0516F002.D: Fluoranthene and Fluoranthene-d10. In accordance with the EPA Method, 80% or more of the CCV analytes must pass within 20% of the true value. The ALS SOP allows for 40% difference for the remaining analytes. The CCV met these criteria. The quality of the sample data was not significantly affected. No further corrective action was required.

Summary of items presented in the sediment chemistry analysis case narrative by ALS Environmental including the corrective actions and corresponding effects on data quality/usability for each item

K1704473 - sediment

Acid-Volatile Sulfide by EPA Method 821/R-91-100: The matrix spike recoveries for sample Batch QC were outside control criteria because of suspected matrix interference. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. No further corrective action was taken.

Diesel and Residual Range Organics by Method AK102/ AK103: The recovery of n-Triacontane and o-Terphenyl in Continuing Calibration Verification (CCV) KWG1704203-3 were outside the control criteria of ± 20% listed in the analytical report. The recovery of the analyte was within the 60-120% control criteria for surrogate recoveries in laboratory quality control samples specified in the AK102/103 method. No further corrective action was necessary.

K1704471 - sediment

The control criteria for matrix spike recovery of Aluminum, Calcium, Iron, Magnesium, Potassium, and Sodium for sample SED17-22 were not applicable. The analyte concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

Antimony recoveries are generally low for soil and sediment samples when digested using EPA Method 3050B. Antimony results (in conjunction with the matrix spike recovery) from this procedure should only be used as indicators to estimate concentrations. The matrix spike recovery of Antimony for sample SED17-22 was below the ALS control criterion. The associated QA/QC results (e.g. control sample, calibration standards, etc.) indicated the analysis was in control.

The matrix spike recovery of Copper for sample SED17-22 was outside the ALS control criteria as a result of the heterogeneous character of the sample. The Relative Percent Difference (RPD) for the replicate analysis supported this. Since the unspiked samples contained high analyte concentrations relative to the amount spiked, the variability between replicates was sufficient to bias the percent recoveries outside normal ALS control criteria. The associated QA/QC results (e.g., control sample, calibration standards, etc.) indicated the analysis was in control. No further corrective action was appropriate.

The Relative Percent Difference (RPD) for the replicate analysis of Calcium and Copper in sample SED17-22 was outside the normal ALS control limits. The variability in the results was attributed to the heterogeneous character of the sample. Standard mixing techniques were used, but were not sufficient for complete homogenization of this sample.

For Polynuclear Aromatic Hydrocarbons by EPA Method 8270:

The control criteria were exceeded for one or more surrogates in the replicate Matrix Spikes (MS/DMS) KWG1703683-1 and KWG1703683-2 of sample Batch QC due to matrix interferences. The presence of non-target background components prevented adequate resolution of the surrogates. Accurate quantitation was not possible. No further corrective action was appropriate

The Matrix Spike (MS) KWG1703683-1 recovery of Fluoranthene for sample Batch QC was outside control criteria. Recoveries in the replicate Laboratory Control Samples (LCS/DLCS) KWG1703683-3 and KWG1703683-4 were acceptable, which indicated the analytical batch was in control. The matrix spike outlier suggested a potential high bias in this matrix. No further corrective action was appropriate.

The Relative Percent Difference (RPD) for Fluoranthene in the replicate Matrix Spikes (MS/DMS) KWG1703683-1 and KWG1703683-2 analyses of Batch QC was outside control criteria. The Relative Percent Difference for the analyte in question in the associated replicate Laboratory Control Samples (LCS/DLCS) KWG1703683-3 and KWG1703683-4 was within acceptance limits, indicating the analytical batch was in control. No further corrective action was appropriate.

Summary of items presented in the sediment chemistry analysis case narrative by ALS Environmental including the corrective actions and corresponding effects on data quality/usability for each item

K1704419 - sediment

Acid-Volatile Sulfide by EPA Method 821/R-91-100: The matrix spike recoveries for sample SED17-09 were outside control criteria because of suspected matrix interference. As a result of the interference, the results for this analyte contained a potential high bias. No further corrective action was taken.

Diesel and Residual Range Organics by Method AK102/ AK103: The recovery of n-Triacontane and o-Terphenyl in Continuing Calibration Verification (CCV) KWG1704203-3 were outside the control criteria of ± 20% listed in the analytical report. The recovery of the analyte was within the 60-120% control criteria for surrogate recoveries in laboratory quality control samples specified in the AK102/103 method. No further corrective action was necessary.

K1704415 - sediment

The control criteria for matrix spike recovery of Aluminum, Calcium, Iron, Magnesium, Potassium, and Sodium for sample DUP-1 were not applicable. The analyte concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

Antimony recoveries are generally low for soil and sediment samples when digested using EPA Method 3050B. The matrix spike recovery of Antimony for sample DUP-1 was below the ALS control criterion. Antimony results (in conjunction with the matrix spike recovery) from this procedure should only be used as indicators to estimate concentrations. The associated QA/QC results (e.g., control sample, calibration standards, etc.) indicated the analysis was in control.

The Relative Percent Difference (RPD) for the replicate analysis of Cadmium and Calcium in sample DUP-1 was outside the normal ALS control limits. Standard mixing techniques were used, but were not sufficient for complete homogenization of this sample.

K1704247 - sediment

The matrix spike recovery of all analyte(s) for sample SED17-05 was outside control criteria. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. The matrix spike outlier suggested a potential bias in this matrix. No further corrective action was appropriate.

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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Golder Associates

APPENDIX D

Sediment Coring Field Data Report

REPORT

Skagway Ore Basin Drilling Investigation

Submitted to:

White Pass & Yukon Route

PO Box 435

Skagway, AK

99840

Submitted by:

Golder Associates Ltd.

#13 - 151 Industrial Road

Calcite Business Centre, Whitehorse, Yukon Territory, Y1A 2V3, Canada

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1657231-007-R-Rev0

13 July 2018

Executive Summary

This Skagway Ore Basin drilling report was prepared by Golder Associates Ltd. (Golder) on behalf of White Pass & Yukon Route (White Pass) and provides a summary of the field activities conducted in October 2017 in support of the human health and ecological risk assessment (HHERA) and remediation planning. This report provides a detailed description of the drilling program, a summary of analytical results and an updated overview of the metals and hydrocarbon concentrations in subsurface sediments in the Skagway Ore Basin (Ore Basin) that incorporates the data from this program with previous coring work that has occurred.

Based on a review of existing site data, ten locations near the Ore dock were selected for subsurface investigation to complement the surficial sediment sampling completed for the risk assessment and other recent coring data to ultimately provide more information when conducting remediation planning.

Three main sediment units were identified during the subsurface sediment sampling program:

- All sample locations along the dock intersected a layer of black organic mud that transitioned from being very soft to soft. This mud had a hydrogen sulphur odour and commonly contained biota (e.g., mussel shells, tube worms). This layer of organic sediment was found at a thickness ranging from 2.5 to 6.7 feet. The soft mud was not encountered at the three step out sample locations located 75 feet from the dock.
- A unit of brown silt and fine sand ranging between 0.2 to 1.2 feet thick was present beneath the organic mud along the dock and as the surficial unit at the locations 75 feet from the dock. Some mussel shells were also found mixed in with this sediment unit.
- Underlying the silt and fine sand sediment was a light grey, coarse sand and gravel unit extending to the maximum depth investigated.

The majority of samples had one or more ore-related metals that exceeded the SCO values. The highest concentrations were of lead, zinc, mercury, silver and copper, and were typically found in the organic mud (shallow samples) and the silt and fine sand unit (middle samples) collected along the dock, to a maximum depth of approximately 7.7 feet below mudline, with the highest concentrations occurring adjacent to the ship loader. The samples collected at step out locations from the dock, directly across from the ore loader, had high concentrations of lead and zinc present in the silt and fine sand unit (middle unit) to a maximum depth of approximately 5.5 feet below mudline as the organic mud was not present.

The locations with high concentrations of lead correspond with high concentrations of zinc and elevated concentrations of mercury and cadmium. The areas near the loading dock also contained elevated concentrations of copper and silver. The majority of the Ore Basin contains concentrations of lead and zinc less than the SCO guidelines.

At least one individual PAH parameter was detected in 13 of the 14 shallow and middle sediment samples submitted for PAH analysis. Most samples had multiple PAHs detected. None of the 14 samples exceeded the total LPAH criteria defined by the WDOE. For total HPAH, there were seven samples that exceeded the SCO guideline. The primary HPAH parameters included Benz(a)anthracene, Benzo(b,j,k)fluoranthrene, Fluoranthrene, and Pyrene. Previous coring investigations in the Ore basin have measured total HPAH concentrations at

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over 1,200 mg/kg, significantly lower that maximum total HPAH of 58.9 mg/kg observed in 2017. The samples with elevated total HPAH concentrations were located near the Ore loader and in various locations throughout the Ore Basin. The source of hydrocarbons in the Ore Basin is not known.

Total coliforms were recorded in 7 of the 13 core samples submitted for analysis. The samples with detected total coliforms were collected from the shallow and medium depths at locations that appear likely to have receiving inputs from the municipal outfall. As with the surficial sampling, the presence of detected coliforms are simply a qualitative indictor that sewage inputs may be influencing sediment quality.

Study Limitations

This report has been prepared for White Pass & Yukon Route Railroad and Alaska Department of Environmental Conservation, and is intended to provide an indication of groundwater quality at the Site. This report may not be relied upon by any other person(s) or entity without the express written consent of Golder Associates Ltd. and the White Pass & Yukon Route Railroad. The inferences concerning the conditions of the Site contained in this report are based on information obtained during the environmental sampling program conducted by Golder personnel, and are based solely on conditions at the time of the sampling. Therefore, the potential remains for the presence of unknown, unidentified or unforeseen contamination in areas not inspected as part of this study.

Any uses that a third party makes of this report, or any reliance on decisions to be made based on it, are the responsibility of such third parties. Golder Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The findings and conclusions documented in this report have been prepared for the specific application to this project, the services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

The content of this report is based on information collected during our environmental sampling, our present understanding of the Site, and our professional judgment in light of such information available at the time of this report. This report provides a professional opinion, and therefore no warranty is either expressed, implied or made as to the conclusions, advice and recommendations offered in this report. This report does not provide a legal opinion regarding compliance with applicable laws. With respect to regulatory compliance issues, it should be noted that regulatory statutes and the interpretation of regulatory statutes are subject to change.

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

This Skagway Ore Basin drilling report was prepared by Golder Associates Ltd. (Golder) on behalf of White Pass & Yukon Route (White Pass) and provides a summary of the field activities conducted in October 2017 in support of the human health and ecological risk assessment (HHERA) and remediation planning. This report provides a detailed description of the drilling program, a summary of analytical results and an updated overview of the metals and hydrocarbon concentrations in subsurface sediments in the Skagway Ore Basin (the "Ore Basin") that incorporates the data from this program with previous coring work that has occurred.

1.1 Objective and Scope of Work

An ecological and human health risk assessment was completed by Golder (Golder, 2018) to determine whether there are unacceptable risks associated with the lead concentrate deposited during the loading activities conducted at the Ore Dock, through a surficial sediment sampling program in the Ore Basin conducted between 25 April and 5 May 2017. A total of 24 stations were sampled for chemistry with select samples selected for toxicity testing. Due to the results of the risk assessment, where surficial chemistry concentrations were lower than previously measured, this additional field program which consisted of coring at deeper depths, was completed to provide additional information for the risk assessment and for remediation planning.

Based on a review of existing Ore Basin data, ten locations near the Ore dock were selected for subsurface investigation to complement the surficial sediment sampling completed for the risk assessment and other recent coring data to ultimately provide supplementary information for remediation planning. The following scope of work was completed for this phase of the project:

- Coring, sediment logging and classification.
- Laboratory analysis for metals, hydrocarbons and sewage indicators.
- A report to summarize the data.

1.2 Site Description

The Skagway Ore Terminal is shown on Figure 1, attached. Skagway Harbour lies at the terminus of a deep fjord (Lynn Canal) on the historical alluvial fan of the Skagway River. The harbour consists of a limited near-shore zone with a typical water depth of between 30 and 40 feet (measured from mean low tide) which transitions rapidly to the deeper waters in Lynn Canal (Anchor 2015). The shoreline of Skagway Harbour was established on the historical alluvial fan through a combination of dredging and filling in the early 1900s (Tetra Tech 2008). Changes to the harbour configuration were made during the construction of the Small Boat Harbour (circa 1958), the State Ferry Terminal (circa 1963), and the expansion of the Ore Terminal (circa 1968), all of which involved dredging and use of the dredged material to expand and reconfigure the shoreline (Anchor 2015).

A brief summary of historical site activities at the Ore Terminal (Anchor 2015) as context for the sampling program:

- The Ore Terminal portion of the harbour was leased by White Pass & Yukon Route (WPYR) from the Municipality of Skagway in the late 1960s and was used for the trans-shipment of lead and zinc ore concentrate from the Faro Mine using an open conveyor system between 1967 and 1982.

- Sporadic use of the facility for shipping ore concentrates continued between 1982 and 1997 with a variety of terminal operators. The conveyor system was enclosed in 1991.
- A concrete dock was added in 2000 to allow the facility to be used by cruise ships, and the historical ore concentrate building was demolished in 2003. A new concentrate building was constructed and has been used for shipment of copper concentrates from the Minto Mine since 2007.

The terminal is currently operated by Alaska Industrial Development and Export Authority (AIDEA). Infrastructure includes a fuel depot (operated by Petro Marine Services) and a container facility (operated by Alaska Marine Lines) in addition to the ore concentrate shipping and cruise ship docking.

2.0 SEDIMENT SCREENING LEVELS

Many jurisdictions establish screening values from a statistical analysis of co-located chemistry and effects data. There are multiple methodologies for deriving empirically-based screening values[1]. The selected screening values for the current assessment were from Washington Department of Ecology (WDOE 2015) who used the apparent effect threshold approach to derive sediment clean up objectives (SCO) and contaminant screening limit (CSL) values. In brief, SCOs and CSLs are derived for each individual substance of interest by examining a database of co-located effects and chemistry data (Barrick et al 1988). Barrick et al. (1988) determined the highest concentration that corresponded to a “no effect” level for four different types of data[2]. The SCO was set to the lowest of the apparent effect thresholds, and the CSL was set to the second-lowest of the apparent effect thresholds (WDOE 2015). For most of the ore-related metals, the lowest apparent effect threshold from Barrick et al. (1998) was based on the benthic abundance data.

Golder understands ADEC is in general agreement that Washington Department of Ecology (WDOE) Sediment Management Standards provide a reasonable basis for showing compliance with Alaska Regulation 18 AAC 75.340(i)(2)(B). WDOE (2015). SCO and CSL values were approved for use in the current assessment by ADEC. The HHERA that has been conducted for the Ore Basin will endeavour to determine site specific effect thresholds which will be used during remedial planning.

Bulk sediment chemistry (e.g., the total concentration of lead, zinc or other substances in sediment) is an important line of evidence in a sediment risk assessment because it provides readily available information about the magnitude of the hazard associated with different substances in sediment (i.e., it can be readily compared to conservative screening values established by regulatory agencies). However, an exceedance of a screening value does not mean that a risk is present.

[1] ADEC (2001) provides an overview of theoretical and empirical (i.e., derived from databases of co-located samples) approaches for deriving sediment guidelines and discusses their applicability to Alaskan sites.

[2] The Barrick et al. (1988) data set is based on n = 50 for Microtox, n = 50 for oyster larval development, n = 201 for benthic abundance and n = 287 for amphipod survival. The decision point (i.e., is there an effect?) is whether a sample demonstrated a statistically significant difference ($p > 0.05$) relative to reference.

3.0 METHODS

Sampling was conducted between 28 October and 31 October 2017. Field investigations were conducted in accordance with ADEC guidance documents and as described below. Sediment sampling was conducted by a Qualified Environmental Professional following a specific work instruction. A field log was maintained to record field observations, time of sampling activities, site sketches, station water depth, split spoon sample recovery, weather conditions, records of observations and discussions.

The drill rig operated by Aquasource LLC of Haines, AK was positioned on board a landing craft, with drill rods placed through the gap at the hinge when the 17' long bow ramp was lowered down parallel to the water. The landing craft was tied to the dock and the seven locations (SED17-32 to SED17-35 and SED17-39 to SED17-41) along the ore dock were measured to be at a distance of 17 feet from the dock (i.e., the vessel would position itself such that the ramp was pushing against the dock pilings). A second row of samples (SED17-36 to SED17-38) was collected at a distance of 75 feet (i.e., the length of the vessel held in position by reversing against the pilings) from the dock. Fixed landmarks (e.g., wharf structures) provided visual confirmation of the locations in the field, and final sample locations were obtained from a hand-held Garmin GPS with an accuracy of ±10 feet.

Subsurface sediment samples were collected using a 2- and 5-foot length split spoon sampler. It was necessary to drive the sampler numerous times to identify the various sediment units and collect sufficient sediment volume for the various analyses. The number of spoon samples needed varied depending on lithology and core recovery. Spoon replicates were collected within a few feet of each other at each station. To achieve this, the landing craft remained in position and the rig was tilted very slightly to the left or right from centre. All sediments recovered were sorted by lithology and composited in stainless steel bowls before being transferred to sample jars.
A description of the sediment with respect to colour, particle size, odour, depth of sediment horizon, and presence of non-sediment materials (e.g., shells, debris, and biota) was recorded. Any obvious debris (e.g., trash, wood) and large rocks were discarded. Volumes recovered were composited in bowls by gently mixing by hand using disposable nitrile gloves. Aliquots of this composite sample were transferred to laboratory-supplied, glass sample jars that were labelled with the sample control number and date. Sample containers were filled to minimize headspace. All homogenization equipment (bowls and spoons) were decontaminated prior to use at the next sampling station. Decontamination entailed washing with a scrub-brush and laboratory-grade detergent (Liquinox®) followed by rinsing with site water.

Samples were packaged in coolers with ice packs for to their transport and delivery to the ALS laboratory in Burnaby, BC. Coolers were shipped via Air North cargo under chain-of-custody procedures and were delivered within appropriate holding times. ALS's laboratory is certified by the Canadian Association for Laboratory Accreditation and is accredited as conforming to ISO/IEC 17025 for analysis.

A copy of the field logs is presented in Appendix A.

Two 4oz glass jars of each sediment unit were submitted for the analysis of total metals, Polycyclic Aromatic Hydrocarbons (PAHs), total and faecal coliforms, and sewage indicators as listed in Table 1 below. Large plastic containers of remaining sediment material available for further testing were kept refrigerated in Whitehorse, YT.

Table 1: Sample Analysis List

Sample Location	Sample ID	Laboratory Analysis			
		Metals	PAHs	Total and Faecal Coliforms	Coprostanol and Cholestanol
SED17-32	SED17-32S	✓	✓	✓	✓
	SED17-32M	✓		✓	✓
SED17-33	SED17-33S	✓	✓	✓	✓
	SED17-33M	✓		✓	
SED17-34	SED17-34S	✓	✓		
	SED17-34M	✓	✓		
	SED17-34D	✓			
SED17-35	SED17-35S	✓		✓	✓
	SED17-35M	✓		✓	✓
	SED17-35D	✓			
SED17-36	SED17-36S	✓	✓		
	SED17-36M	✓	✓		
	SED17-36D	✓			
SED17-37	SED17-37M	✓	✓	✓	✓
	SED17-37D	✓			
SED17-38	SED17-38S	✓	✓	✓	✓
	SED17-38M	✓	✓		
	SED17-38D	✓			
SED17-39	SED17-39S	✓	✓	✓	✓
	SED17-39M	✓		✓	✓
	SED17-39D	✓			
SED17-40	SED17-40M	✓	✓	✓	✓
	SED17-40D	✓			
SED17-41	SED17-41S	✓	✓	✓	✓
	SED17-41M	✓	✓	✓	✓
	SED17-41D	✓			

Notes: ✓ = Parameter analysis performed by ALS laboratory

The locations of all subsurface sediment samples collected in 2017 are provided on Figure 1, attached.

Photographs of the field activities are provided in Appendix B.

4.0 RESULTS

4.1 Sediment Classification

Three main sediment units were identified during the subsurface sediment sampling program:

- All sample locations along the dock intersected a layer of black organic mud that transitioned from being very soft to soft. This mud had a hydrogen sulphur odour and commonly contained biota (e.g., mussel shells, tube worms). This layer of organic sediment was found at a thickness ranging from 2.5 to 6.7 feet. The soft mud was not encountered in the three sample locations located 75 feet from the dock.
- A unit of brown silt and fine sand ranging between 0.2 to 1.2 feet thick was present beneath the organic mud near the dock and as the surficial unit in the locations 75 feet from the dock. Some mussel shells were also found mixed in with this sediment unit.
- Underlying the silt and fine sand sediment was a light grey, coarse sand and gravel unit extending to the maximum depth investigated.

Figure 2: Core sample from location SED17-38 showing the three different sediment classifications

The various stratigraphic units encountered in each of the coring samples drilled on the west side of the Ore Basin are shown in the graphic below. The organic mud (purple) is shown to be primarily along the slope adjacent to the Ore Dock and above the general base elevation of the Ore Basin. The base of the Ore basin consists of silt and fine-grained sand, with gravel also encountered below the silt and fine sand in some locations.

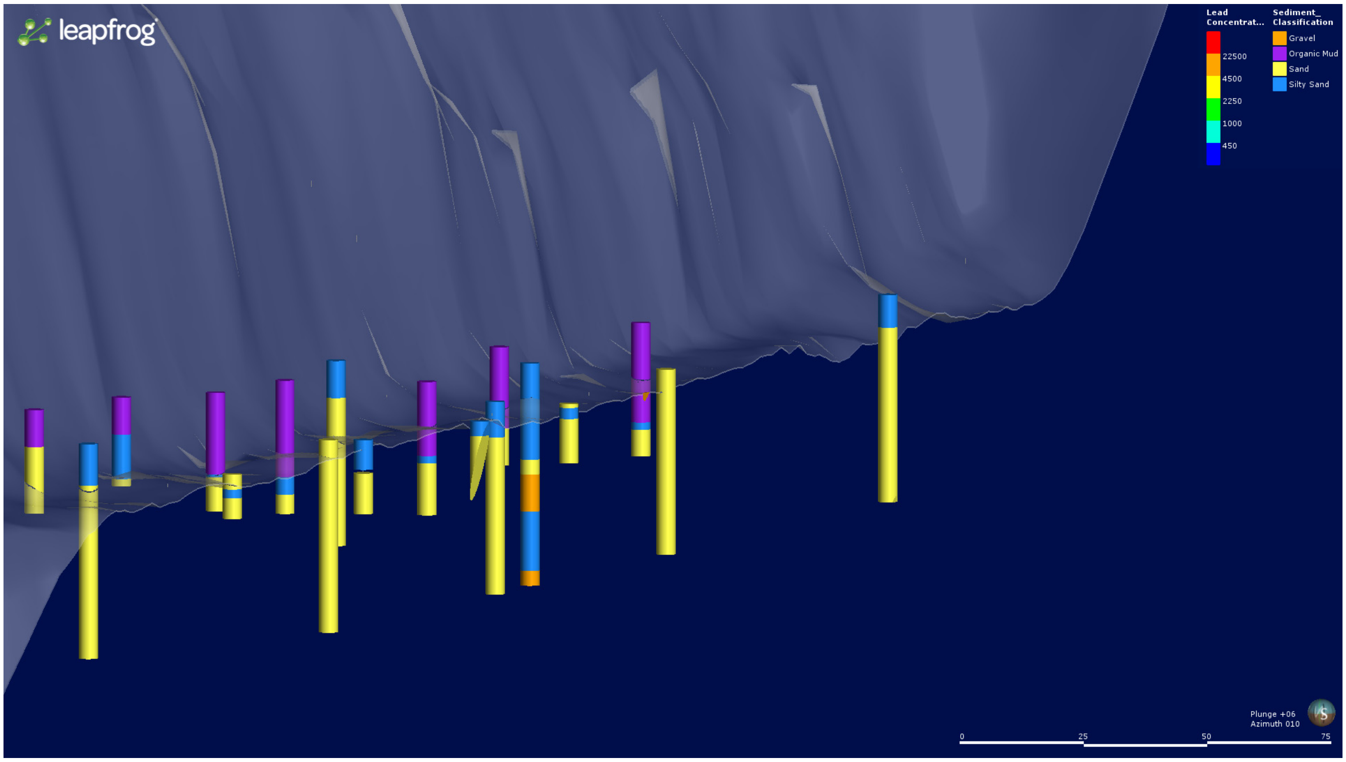

Figure 3: Stratigraphy along Ore Basin Dock looking northwest (Lynn Canal to the left, Skagway to the right)

The maximum investigation depths ranged between 3 and 9 feet below mudline, due to the variation in the thickness of the organic mud. The start of the shallowest sample interval was based on where the sampler would retain sediment. In many cases the top of the organic mud was too soft to be retained in the split spoon sampler. The end depth of the deepest sample interval at each location corresponds to the maximum investigation depth (in feet below mudline) in Table 2.

Table 2: Sample Sediment Classification and Interval Depths

Sample location	Sample ID	Sediment Classification	Sample Interval Start	Sample Interval End
			(feet below mudline)	
SED17-32	SED17-32S	Organic mud and fine sand	2.0	2.5
	SED17-32M	Sand and gravel, some silt	2.5	7.0
SED17-33	SED17-33S	Organic mud	2.0	2.5
	SED17-33M	Silt and fine sand	2.5	3.5
SED17-34	SED17-34S	Organic mud	4.0	5.5
	SED17-34M	Silt and fine sand	5.5	5.7
	SED17-34D	Coarse sand, some gravel	5.7	8.0
SED17-35	SED17-35S	Organic mud	6.0	6.5
	SED17-35M	Silt and fine sand	6.5	7.7
	SED17-35D	Coarse sand, some gravel	7.7	9.0
SED17-36	SED17-36S	Organic mud	4.0	5.0
	SED17-36M	Silt and fine sand	5.0	5.5
	SED17-36D	Coarse sand, some gravel	5.5	9.0
SED17-37	SED17-37M	Organic mud and silt	5.0	5.5
	SED17-37D	Coarse sand, some gravel	5.5	8.0
SED17-38	SED17-38S	Organic mud	6.0	6.7
	SED17-38M	Silt and fine sand	6.7	7.2
	SED17-38D	Coarse sand, some gravel	7.2	9.0
SED17-39	SED17-39S	Coarse sand and mussel shells	1.0	1.1
	SED17-39M	Silt, some fine sand	1.1	1.6
	SED17-39D	Coarse sand some gravel	1.6	3.0
SED17-40	SED17-40M	Silt and fine sand	2.0	2.3
	SED17-40D	Medium to coarse sand	2.3	5.0
SED17-41	SED17-41S	Fine sand	0.0	0.3
	SED17-41M	Silt and fine sand	0.3	1.0
	SED17-41D	Fine to coarse sand	1.0	4.0

4.2 Laboratory Analytical Results

Copies of the ALS analytical reports for the sediment chemistry analyses performed on the samples are provided in Appendix C, and a sediment chemistry data table is provided in Table A-1, attached. These data were screened against the numerical standards (SCO: sediment cleanup objective, and CSL: cleanup screening levels) as described by the Washington State Department of Ecology (WDOE 2015).

4.2.1 Total Metals

The following is a summary of the results by location from along the Ore Dock from south to north:

- SED17-32 – no exceedances of the SCO or CSL.
- SED17-33 – exceedance of lead (705 mg/kg) of the SCO and CSL and exceedance of mercury (0.428 mg/kg) and zinc (555 mg/kg) of the SCO in the mid-level sample only.
- SED17-39 – exceedance of zinc (539 mg/kg) of the SCO in the mid-level sample only.
- SED17-40 – no exceedances of the SCO or CSL.
- SED17-34 (adjacent to ore loader) – exceedances of cadmium (7.24, 12.8 mg/kg), lead (2500, 4570 mg/kg), mercury (3.19, 5.67 mg/kg) and zinc (4590, 8240 mg/kg) of the SCO and CSL in the shallow and mid-level samples respectively. No exceedances in the deep sample.
- SED 17-35 – exceedances of cadmium (34.3, 16.2 mg/kg), copper (465 mg/kg), lead (19500, 14700 mg/kg), mercury (13.7, 6.56 mg/kg), silver (21.9, 14.1 mg/kg), and zinc (21600, 10300 mg/kg) of the SCO and CSL in the shallow and mid-level samples respectively. The deep sample contained exceedances of lead (493 mg/kg) and zinc (458 mg/kg) of the SCO.
- SED17-41 – exceedances of cadmium (5.83, 7.31 mg/kg), lead (2200, 3030 mg/kg), mercury (2.18, 2.47 mg/kg) and zinc (3730, 4610 mg/kg) of the SCO and CSL in the mid-level and deep samples respectively.

Three locations were drilled approximately 75' from the Ore dock. Results from south to north contained the following exceedances:

- SED17-38 – exceedances of lead (840, 547 mg/kg), mercury (0.96, 0.54 mg/kg) and zinc (1390, 893 mg/kg) of the SCO and/or CSL in the shallow and mid-level samples respectively.
- SED17-37 – exceedances of cadmium (30.1 mg/kg), copper (436 mg/kg), lead (14100 mg/kg), mercury (12.7 mg/kg), silver (15.2 mg/kg), and zinc (19400 mg/kg) of the SCO and CSL in the mid-level sample.
- SED17-36 (adjacent to ore loader) – exceedances of cadmium (105, 50.6 mg/kg), copper (1400, 472 mg/kg), lead (41900, 14400 mg/kg), mercury (38.7, 20.9 mg/kg), silver (43.6, 15.3 mg/kg), and zinc (73800, 33400 mg/kg) of the SCO and CSL in the shallow and mid-level samples respectively.

4.2.2 Hydrocarbons

At least one individual Polycyclic Aromatic Hydrocarbon (PAH) parameter was detected in 13 of the 14 shallow and middle sediment samples submitted for PAH analysis, with the exception of sample SED17-40M which had no detectable PAHs. Most samples had a minimum of seven detected PAH concentrations with numerous exceedances of the SCO and CSL guidelines. Although there were exceedances of individual low molecular weight PAHs (LPAH), namely in SED17-34M and SED17-36S, there were no exceedances of the total LPAH criteria defined by the WDOE. Primary LPAH parameters included Phenanthrene and Anthracene.

For total high molecular weight PAHs (HPAH), there were seven samples that had exceedances of the SCO guideline (12 mg/kg) and five samples that exceeded the CSL (17 mg/kg) guideline. The primary HPAH parameters included Benzo(a)anthracene, Benzo(b,j,k)fluoranthrene, Fluoranthrene, and Pyrene.

4.2.3 Sewage Indicator Parameters

Shallow and mid-level samples were analyzed for faecal and total coliforms. Total coliforms (>2 colonies) were recorded in 7 of the 13 samples submitted for analysis. The samples with total coliforms were collected from the shallow and medium samples at locations across from the sewage outfall (SED17-32, -33, -37, -38) and from SED17-41.

Two sewage indicator parameters were analyzed in the shallow and middle samples, Cholestanol and Coprastanol. Cholestanol was detected in four of the twelve samples submitted for sewage indicator analysis, with concentrations ranging between 0.066 and 0.415 mg/kg and one detection of Coprastanol (0.062 mg/kg). Cholestanol and Coprastanol are typically degraded in aerobic conditions and would not be expected in subsurface sediment except in an environment with continual loadings such as where a sewage outfall is located nearby.

4.3 Quality Assurance/Quality Control

Standard Golder and industry established field procedures were used throughout the field investigation to improve accuracy, precision and reproducibility of results. The samples were stored in chilled coolers prior to submission to the analytical laboratory and appropriately completed Chain-of-Custody forms accompanied the sample submissions.

Field notes were maintained to document the field sampling program. Additional field QA/QC activities sample collection included the following:

- Sampling equipment such as bowls and spoons were cleaned with a laboratory-grade detergent and rinsed with site water prior to use at each station.
- Sediment samples were collected by hand using single-use disposable nitrile gloves and placed into clean glass sample jars provided by the laboratory that were labelled with the unique sample control number and date.
- Field duplicates were collected from 2 of the 26 sediment samples. Sediment field duplicates were taken as split samples from the composite sample, with samples SED17-34M and SED17-41M selected for QA/QC purposes in this investigation.

- Samples were carefully packaged to prevent breakage and shipped with ample ice to maintain the samples at the appropriate temperature.
- The relative percent difference (RPD) was calculated to assess variability between field duplicates as follows:

$$RPD = \left(\frac{sample - duplicate}{(sample + duplicate)/2}\right) \times 100$$

The relative percent differences for the field duplicates are provided in Table A-2. A specific limit for RPDs is not specified by ADEC (2016), but in general an RPD of greater than 30% can indicate instances where sample homogenization may have been insufficient. This is not a pass/fail criterion because high RPDs can be generated by “nugget effects” that can impact RPDs despite all reasonable effort for appropriate sample homogenization. RPDs are also only calculated when both the original and field duplicate concentrations are greater than five times the detection due to analytical uncertainty near the method detection limit which does not provide a good measure of variability associated with the collection of field samples. A total of two field duplicates were collected for the subsurface sediment sampling program. Golder concluded that the field duplicate RPDs were acceptable and that there was no impact on sediment quality. RPDs were less than 30% for the main metals of interest in one of the two duplicate pairs. The specific results of the field duplicates and a discussion with respect to data quality are as follows:

- SED17-34M and SED17-34M-DUP had RPDs ranging from 1 to 74%. All of the RPDs that exceeded 30% were associated with individual PAHs. Golder reviewed the field notes for this sample and confirmed that appropriate sample homogenization was conducted. Golder concluded that the high RPDs with respect to PAHs were relevant for site characterization. The original sample had five more exceedances with respect to PAHs than the duplicate sample. Golder will use the PAH concentrations from the original sample to provide a conservative evaluation of this sample.
- SED17-41M and SED17-41M-DUP had RPDs ranging from 0 to 102%. PAHs were not analysed for the duplicate sample. Nine RPDs exceeded the 30% trigger, including all metals of concern frequently exceeding the SCO criteria. Golder reviewed the field notes for this sample and confirmed that appropriate sample homogenization was conducted. Golder concluded that the high RPDs with respect to metals were relevant for site characterization. In one instance, the concentration of cadmium in the original sample had an exceedance where the duplicate did not. Golder will use the concentration from the original sample to provide a conservative evaluation of this sample. In all other instances both the original sample and the duplicate either exceeded the SCO/CSL criteria, or both were less than the criteria.
- Sample SED17-35M exceeded the recommended holding time of 48h for coliform analysis due to an omission by the laboratory. This sample did not have coliforms detected.

The analytical laboratory provided a case narrative for each certificate of analysis which discussed the internal laboratory control measures. There were no deviations described in the case narratives which were considered by the analytical laboratory to impact overall data quality. The ADEC laboratory review checklist was completed by Golder and is provided in Appendix C. Overall, Golder concludes that the sediment data are reliable and suitable for the assessment based on consideration of both the laboratory and field QA/QC components.

5.0 SEDIMENT CHARACTERIZATION SUMMARY

5.1 Metals

The laboratory data was screened against numerical standards (SCO: sediment cleanup objective, and CSL: cleanup screening levels) as described by the Washington State Department of Ecology (WDOE 2015). Data are provided in Table A-1 and Appendix C, but overall, the majority of samples had one or more ore-related metals that exceeded the SCO values. The highest concentrations were associated with lead, zinc, mercury and copper, and were typically found in the organic mud (shallow samples) and the silt and fine sand unit (mid-level samples) collected along the dock, to a maximum depth of approximately 7.7 feet below mudline with the highest concentrations occurring adjacent to the ship loader. In the samples collected in the step out locations from the dock, directly across from the ore loader, high concentrations of lead and zinc were present in the silt and fine sand unit (middle unit) to a maximum depth of approximately 5.5 feet below mudline as the organic mud was not present.

The highest concentrations of metals are co-located. The locations with high concentrations of lead also have high concentrations of zinc and elevated concentrations of mercury and cadmium. The areas near the loading dock also contained elevated concentrations of copper and silver. The following figure shows the spatial distribution of lead concentrations with depth along the Ore Dock (left to right) and across the Ore basin. The figure indicates that the highest concentrations of lead are localized near the Ore loader while the majority of the Ore Basin is less than the SCO (450 mg/kg) and CSLs (530 mg/kg).

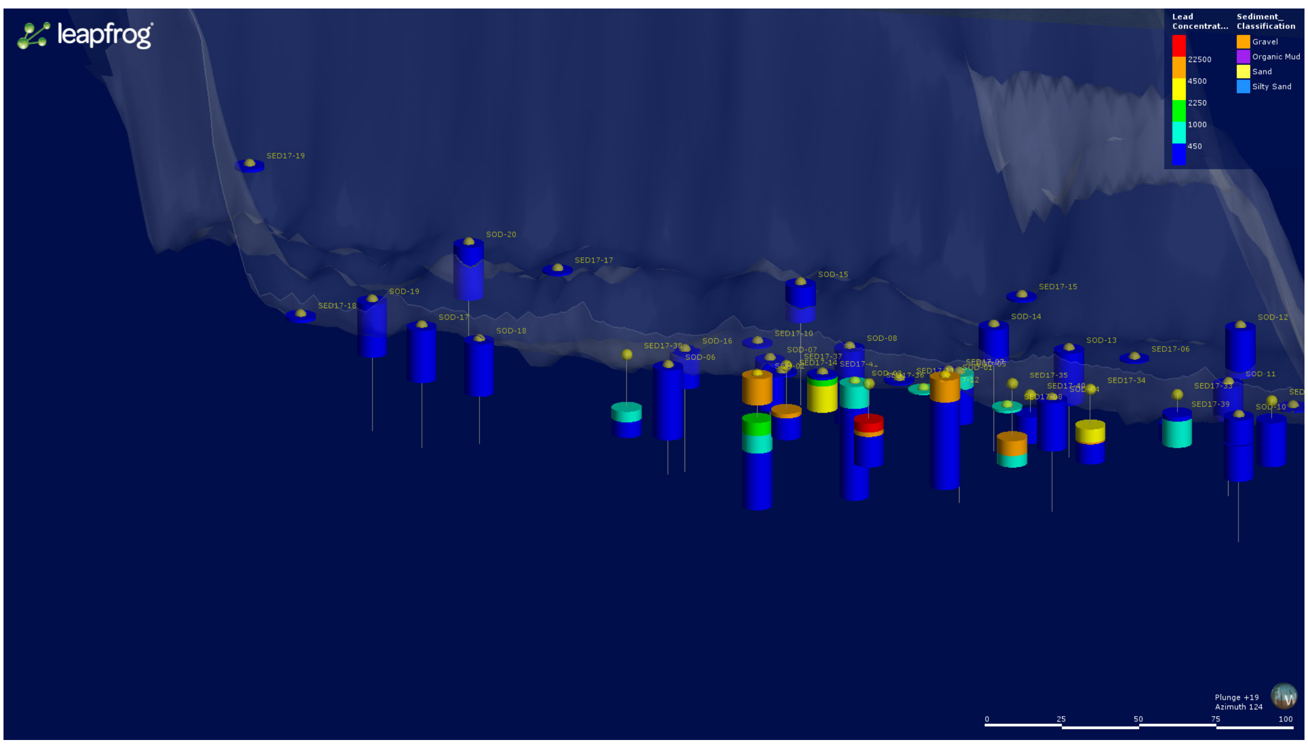

Figure 4: Spatial Distribution of Lead concentrations along Ore Dock and into Ore Basin (looking northeast)

The spatial distribution of zinc concentrations is similar to that of lead. The highest concentrations are in the vicinity of the Ore loader with some elevated concentrations that have migrated along the Ore Dock. The figure also illustrates that the majority of the Ore Basin contains concentrations of zinc less than the SCO (410 mg/kg).

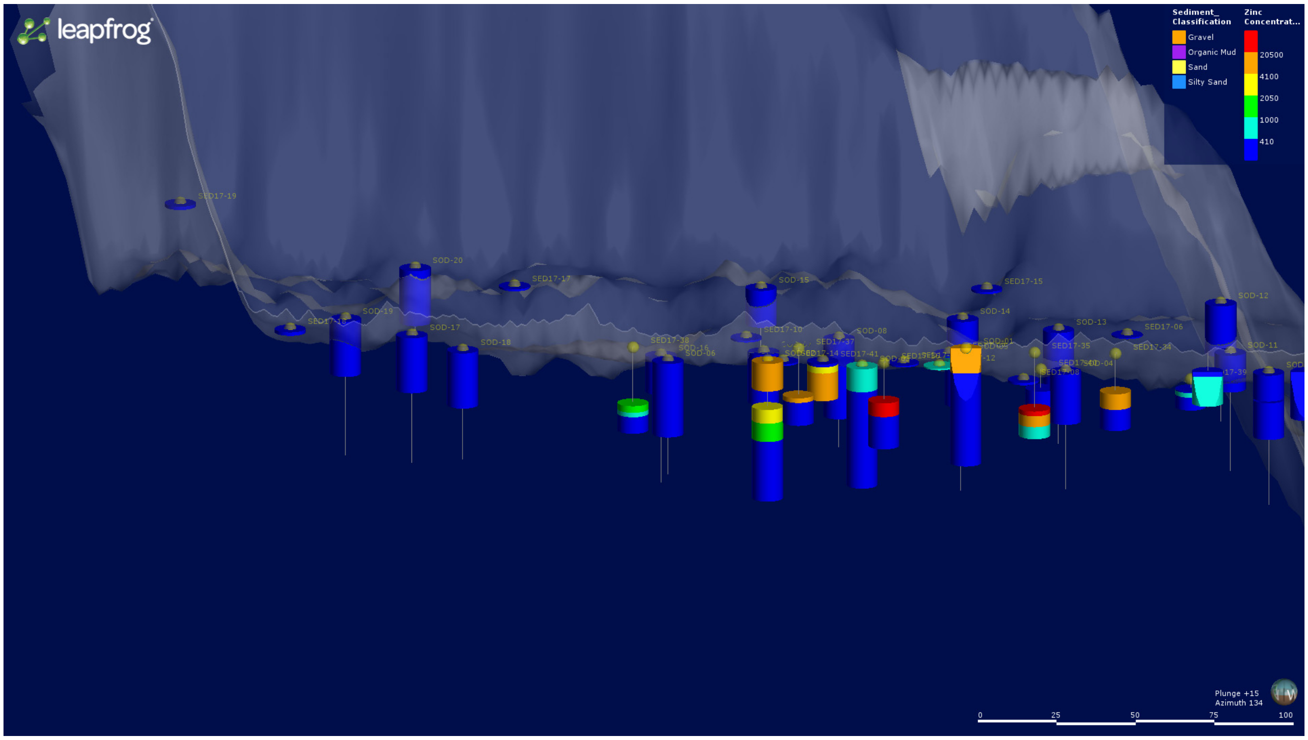

Figure 5: Spatial Distribution of Zinc Concentrations along Ore Dock and into Ore Basin (looking northeast)

Overall, there appears to be a pattern that elevated concentrations of the metals of concern are limited to the shallow and mid-level samples collected primarily near the ore-loader, to a maximum depth of approximately 7.7 feet below mudline.

5.2 Hydrocarbons

At least one individual PAH parameter was detected in 13 of the 14 shallow and mid-level sediment samples submitted for PAH analysis. Most samples had multiple PAHs detected. None of the 14 samples exceeded the total LPAH criteria defined by the WDOE. For total HPAH, there were seven samples that exceeded the SCO guideline (12 mg/kg) and five samples that exceeded the CSL (17 mg/kg) guideline. This was generally consistent with the findings from the surface sampling, although the number and magnitude of exceedances for total HPAHs were greater in the core samples. The highest total HPAH concentration was 58.8 mg/kg in the mid-level sample from SED17-34. Previous coring investigations in the Ore basin have measured total HPAH concentrations at over 1,200 mg/kg. The following figure of total HPAH concentrations shown by depth and spatial distribution indicates that there are high concentrations located near the Ore loader and at various locations throughout the Ore Basin. The source of hydrocarbons in the Ore Basin is not known.

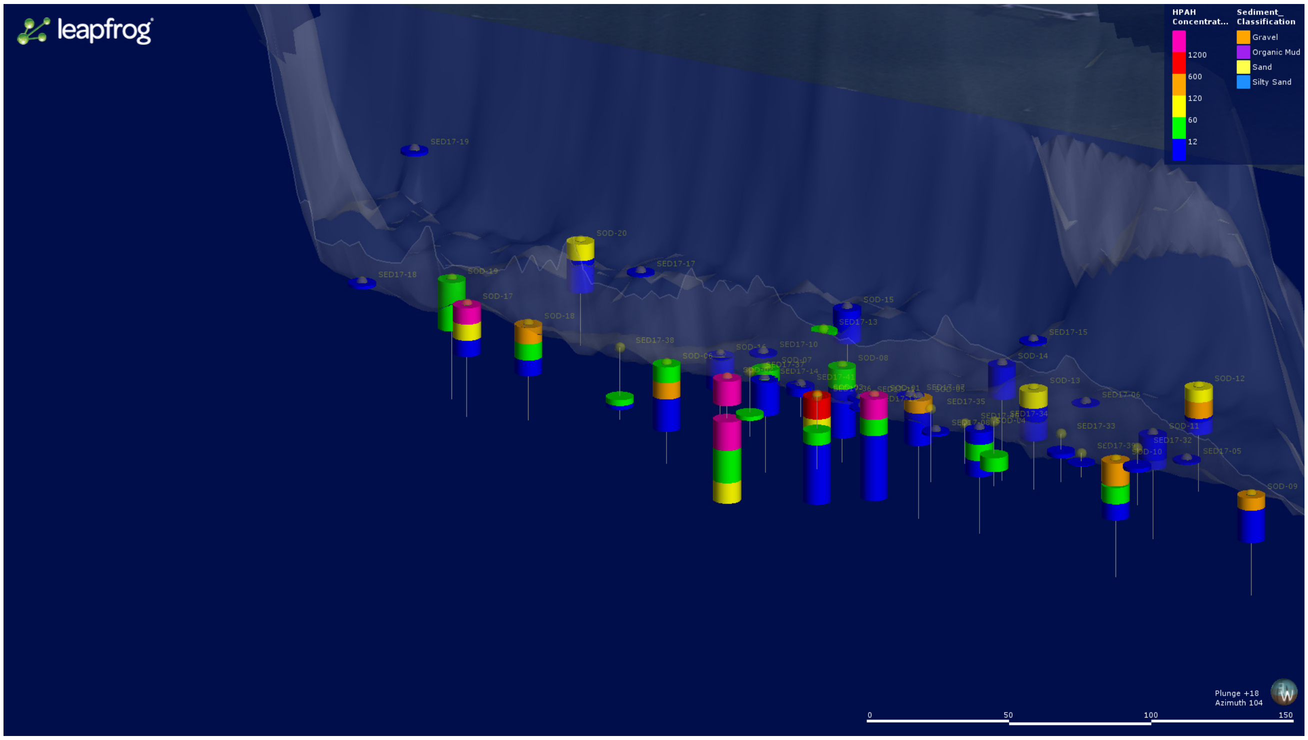

Figure 6: Spatial Distribution of total HPAH concentrations through Ore Basin (looking northeast)

5.3 Sewage Indicator Parameters

Golder also submitted core samples for coprostanol, cholestenol, total and faecal coliforms due to the results of the shallow sediment testing results that indicated that some of the data may have been impacted by the presence of faecal matter. Total coliforms were recorded in 7 of the 13 core samples submitted for analysis. The samples with detected total coliforms were collected from the shallow and medium depths at locations that appear likely to have receiving inputs from the municipal outfall (SED17-32, -33, -37, -38) and from SED17-41.

Cholestanol is a by-product of mammalian gut metabolism similar to coprostanol. Cholestanol was detected in four of the twelve samples submitted for analysis. As noted in the risk assessment report, there are multiple factors that can influence the quantified concentrations of these types of indicators. The purpose of including these indicators in the core sampling was to provide analysis that were not biased by an extended hold time. As with the surficial sampling, the presence of detected concentrations of the substances are simply a qualitative indictor that sewage inputs may be influencing sediment quality.

6.0 CONCLUSIONS

Based on a review of existing site data, ten locations near the Ore dock were selected for subsurface investigation to complement the surficial sediment sampling completed for the risk assessment and other recent coring data to ultimately provide more information when conducting remediation planning.

Three main sediment units were identified during the subsurface sediment sampling program:

- All sample locations along the dock intersected a layer of black organic mud that transitioned from being very soft to soft. This mud had a hydrogen sulphur odour and commonly contained biota (e.g., mussel shells, tube worms). This layer of organic sediment was found at a thickness ranging from 2.5 to 6.7 feet. The soft mud was not encountered at the three step out sample locations located 75 feet from the dock.
- A unit of brown silt and fine sand ranging between 0.2 to 1.2 feet thick was present beneath the organic mud along the dock and as the surficial unit at the locations 75 feet from the dock. Some mussel shells were also found mixed in with this sediment unit.
- Underlying the silt and fine sand sediment was a light grey, coarse sand and gravel unit extending to the maximum depth investigated.

The majority of samples had one or more ore-related metals that exceeded the SCO values. The highest concentrations were of lead, zinc, mercury, silver and copper, and were typically found in the organic mud (shallow samples) and the silt and fine sand unit (middle samples) collected along the dock, to a maximum depth of approximately 7.7 feet below mudline, with the highest concentrations occurring adjacent to the ship loader. The samples collected at step out locations from the dock, directly across from the ore loader, had high concentrations of lead and zinc present in the silt and fine sand unit (middle unit) to a maximum depth of approximately 5.5 feet below mudline as the organic mud was not present.

The locations with high concentrations of lead correspond with high concentrations of zinc and elevated concentrations of mercury and cadmium. The areas near the loading dock also contained elevated concentrations of copper and silver. The majority of the Ore Basin contains concentrations of lead and zinc less than the SCO guidelines.

At least one individual PAH parameter was detected in 13 of the 14 shallow and middle sediment samples submitted for PAH analysis. Most samples had multiple PAHs detected. None of the 14 samples exceeded the total LPAH criteria defined by the WDOE. For total HPAH, there were seven samples that exceeded the SCO guideline. The primary HPAH parameters included Benz(a)anthracene, Benzo(b,j,k)fluoranthrene, Fluoranthrene, and Pyrene. Previous coring investigations in the Ore basin have measured total HPAH concentrations at over 1,200 mg/kg, significantly lower that maximum total HPAH of 58.9 mg/kg observed in 2017. Samples with elevated total HPAH concentrations were located near the Ore loader and in various locations throughout the Ore Basin. The source of hydrocarbons in the Ore Basin is not known.

Total coliforms were recorded in 7 of the 13 core samples submitted for analysis. The samples with detected total coliforms were collected from the shallow and medium depths at locations that appear likely to have receiving inputs from the municipal outfall. As with the surficial sampling, the presence of detected coliforms are simply a qualitative indictor that sewage inputs may be influencing sediment quality.

7.0 CLOSURE

We trust this information is sufficient for your needs at this time. Should you have any questions or concerns, please do not hesitate to contact the undersigned at 1-867-633-6076.

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ER/TR/syd

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Table A-1
Summary of Sediment Chemistry Analysis

Sample Name	Marine Sediment AETs [1,2]		Units	SED17-32S	SED17-32M	SED17-33S	SED17-33M	SED17-34S	SED17-34M	SED17-34M-DUP	SED17-34D	SED17-35S	SED17-35M	SED17-35D	SED17-36S
Sediment classification				Organic mud and fine sand	Sand and gravel, some silt	Organic mud	Silt and fine sand	Organic mud	Silt and fine sand	Silt and fine sand	Coarse sand, some gravel	Organic mud	Silt and fine sand	Coarse sand, some gravel	Organic mud
Location on map				1S	1M	2S	2M	3S	3M	3M	3D	4S	4M	4D	5S
Sample Control Number (SCN)				7977-01	7977-02	7977-03	7977-04	07979-04	07979-02	07979-05	07979-03	07979-07	07979-06	07979-08	07980-01
Sample Date				28-Oct-2017	28-Oct-2017	28-Oct-2017	28-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017
Sample Depth (ft below mudline)				2 - 2.5	2.5 - 7	2 - 2.5	2.5 - 3.5	4 - 5.5	5.5 - 5.7	5.5 - 5.7	5.7 - 8	6 - 6.5	6.5 - 7.7	7.7 - 9	2 - 5
Sample Time	SCO	CSL		14:50	14:50	18:30	18:30	13:30	13:30	13:30	13:30	14:30	14:30	14:30	15:40
Physical Tests															
Moisture	-	-	%	23.8	17.7	24.1	22.6	33.4	25.8	26.3	-	35.6	15.4	-	29.7
pH (1:2 soil:water)	-	-	pH	8.58	8.65	8.57	8.59	8.53	8.51	8.60	8.75	8.42	8.42	8.18	8.29
Bacteriological Tests															
Coliform Bacteria - Fecal	-	-	MPN/g	<2	<2	<2	<2	-	-	-	-	<2	<2	-	-
Coliform Bacteria - Total	-	-	MPN/g	4	4	3	3	-	-	-	-	<2	<2	-	-
Sterols															
Cholestanol	-	-	mg/kg	0.099	<0.050	0.415	-	-	-	-	-	<0.050	<0.050	-	-
Coprostanol	-	-	mg/kg	<0.050	<0.050	0.062	-	-	-	-	-	<0.050	<0.050	-	-
Metals															
Antimony (Sb)	-	-	mg/kg	0.12	0.11	0.17	0.63	2.65	5.08	4.42	0.13	23.4	14.9	0.54	50.4
Arsenic (As)	57	93	mg/kg	1.95	1.09	2.31	1.87	8.39	7.79	6.64	0.65	22.8	10.7	0.81	41.2
Barium (Ba)	-	-	mg/kg	210	135	192	168	389	329	282	109	341	211	121	119
Beryllium (Be)	-	-	mg/kg	0.20	0.12	0.17	0.17	0.34	0.29	0.24	0.11	0.37	0.16	<0.10	0.28
Cadmium (Cd)	5.1	6.7	mg/kg	0.296	0.183	0.411	0.901	7.24	12.8	9.82	0.358	34.3	16.2	0.638	105
Chromium (Cr)	260	270	mg/kg	11.2	6.53	18.9	9.16	22.6	16.9	14.6	4.64	21.5	8.09	5.68	16.3
Cobalt (Co)	-	-	mg/kg	5.17	3.38	5.01	4.17	8.88	7.86	6.79	2.73	10.7	4.93	2.97	12.2
Copper (Cu)	390	390	mg/kg	33.1	11.3	43.4	32.4	339	162	123	6.33	465	185	10.2	1400
Lead (Pb)	450	530	mg/kg	57.9	72.5	159	705	2500	4570	3280	115	19500	14700	493	41900
Mercury (Hg)	0.41	0.59	mg/kg	0.075	0.074	0.136	0.428	3.19	5.67	4.39	0.139	13.7	6.56	0.268	38.7
Molybdenum (Mo)	-	-	mg/kg	1.00	0.48	0.97	1.59	2.17	2.40	1.72	0.40	4.44	1.31	0.35	6.30
Nickel (Ni)	-	-	mg/kg	6.04	3.13	8.22	4.22	10.6	8.39	7.45	2.26	11.6	3.97	2.48	9.72
Selenium (Se)	-	-	mg/kg	<0.20	<0.20	<0.20	<0.20	0.34	0.33	0.24	<0.20	0.98	0.55	<0.20	3.02
Silver (Ag)	6.1	6.1	mg/kg	0.13	0.10	0.21	0.72	3.28	5.21	3.99	0.15	21.9	14.1	0.51	>43.6
Thallium (Tl)	-	-	mg/kg	0.179	0.114	0.179	0.205	0.614	0.956	0.726	0.103	3.96	2.44	0.182	7.44
Tin (Sn)	-	-	mg/kg	<2.0	<2.0	<2.0	<2.0	25.9	3.6	6.9	<2.0	6.7	2.5	<2.0	9.1
Uranium (U)	-	-	mg/kg	1.37	1.09	1.36	1.39	2.04	1.86	1.76	1.58	2.53	1.24	0.672	1.92
Vanadium (V)	-	-	mg/kg	37.9	24.8	34.0	30.5	63.9	52.0	45.0	19.2	68.6	29.7	21.1	51.2
Zinc (Zn)	410	960	mg/kg	165	141	231	555	4590	8240	6180	242	21600	10300	458	73800
Polycyclic Aromatic Hydrocarbons															
Acenaphthene	0.5	0.5	mg/kg	<0.050	-	<0.050	-	0.0503	0.142	0.149	-	-	-	-	0.0861
Acenaphthylene	1.3	1.3	mg/kg	<0.050	-	<0.050	-	0.129	0.0888	0.0686	-	-	-	-	0.0596
Anthracene	0.96	0.96	mg/kg	<0.050	-	0.069	-	0.428	1.58	0.728	-	-	-	-	0.466
Fluorene	0.54	0.54	mg/kg	<0.050	-	<0.050	-	0.178	0.62	0.448	-	-	-	-	0.223
Naphthalene	2.1	2.1	mg/kg	0.098	-	0.148	-	0.013	0.015	0.019	-	-	-	-	0.011
Phenanthrene	1.5	1.5	mg/kg	0.311	-	0.614	-	0.720	2.02	1.20	-	-	-	-	2.19
2-Methylnaphthalene	0.67	0.67	mg/kg	<0.050	-	<0.050	-	0.017	0.020	0.017	-	-	-	-	0.012
Total LPAH	5.2	5.2	mg/kg	*0.409*	-	*0.831*	-	*1.5353*	*4.4888*	*2.6296*	-	-	-	-	*3.0477*
Benz(a)anthracene	1.3	1.6	mg/kg	0.112	-	0.237	-	2.90	8.09	4.48	-	-	-	-	2.28
Benzo(a)pyrene	1.6	1.6	mg/kg	0.074	-	0.109	-	1.25	2.85	1.89	-	-	-	-	1.54
Benzo(k)fluoranthene	-	-	mg/kg	0.289	-	0.287	-	1.27	3.08	1.67	-	-	-	-	1.32
Benzo(b&j)fluoranthene	-	-	mg/kg	0.186	-	0.250	-	3.75	8.79	5.67	-	-	-	-	4.03
Benzo(b+j+k)fluoranthene	3.2	3.6	mg/kg	<0.050	-	<0.050	-	5.02	11.90	7.34	-	-	-	-	5.36
Benzo(g,h,i)perylene	0.67	0.72	mg/kg	0.073	-	0.097	-	0.278	0.554	0.402	-	-	-	-	0.484
Chrysene	1.4	2.8	mg/kg	<0.050	-	<0.050	-	<2.0	6.94	<3.0	-	-	-	-	2.34
Dibenz(a,h)anthracene	0.23	0.23	mg/kg	0.177	-	0.503	-	0.143	0.370	0.223	-	-	-	-	0.193
Fluoranthene	1.7	2.5	mg/kg	<0.050	-	<0.050	-	5.21	15.8	10.1	-	-	-	-	4.20
Indeno(1,2,3-c,d)pyrene	0.6	0.69	mg/kg	<0.050	-	<0.050	-	0.368	0.706	0.490	-	-	-	-	0.631
Pyrene	2.6	3.3	mg/kg	<0.050	-	<0.050	-	7.89	11.6	8.32	-	-	-	-	7.24
Total HPAH	12	17	mg/kg	*0.436*	-	*0.946*	-	*23.059*	*58.810*	*33.245*	-	-	-	-	*24.268*
1-Methylnaphthalene	-	-	mg/kg	<0.050	-	<0.050	-	<0.050	<0.050	<0.050	-	-	-	-	<0.050
Quinoline	-	-	mg/kg	86.5	-	89.6	-	<0.050	<0.050	<0.050	-	-	-	-	<0.050

Sample Name	SED17-36M	SED17-36D	SED17-37M	SED17-37D	SED17-38S	SED17-38M	SED17-38D	SED17-39S	SED17-39M	SED17-39D	SED17-40M	SED17-40D	SED17-41S	SED17-41M	SED17-41M-DUP	SED17-41D
Sediment classification	Silt and fine sand	Coarse sand, some gravel	Organic mud and silt	Coarse sand, some gravel	Organic mud	Silt and fine sand	Coarse sand, some gravel	Coarse sand and mussel shells	Silt, some fine sand	Coarse sand some gravel	Silt and fine sand	Medium to coarse sand	Fine sand	Silt and fine sand	Silt and fine sand	Fine to coarse sand
Location on map	5M	5D	6M	6D	7S	7M	7D	8S	8M	8D	9M	9D	10S	10M	10M	10D
Sample Control Number (SCN)	07979-12	07980-02	07978-04	07978-03	07979-09	07979-10	07979-11	07979-01	07978-12	07978-11	07978-09	07978-10	07978-07	07978-06	07978-08	07978-05
Sample Date	31-Oct-2017	31-Oct-2017	30-Oct-2017	30-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017	31-Oct-2017
Sample Depth (ft below mudline)	5 - 5.5	5.5 - 9	5 - 5.5	5.5 - 8	6 - 6.7	6.7 - 7.2	7.2 - 9	1 - 1.1	1.1 - 1.6	1.6 - 3	2 - 2.3	2.3 - 5	0 - 0.3	0.3 - 1.0	0.3 - 1.0	1.0 - 4.0
Sample Time	17:00	15:40	0:00	0:00	15:40	15:40	15:40	12:15	12:15	12:15	10:30	10:30	9:20	9:20	9:20	9:20
Physical Tests																
Moisture	19.2	-	25.2	14.7	38.4	24.6	-	17.6	20.0	-	15.5	-	17.1	23.4	-	-
pH (1:2 soil:water)	8.46	8.70	8.25	8.02	8.36	8.49	8.64	8.42	8.33	8.45	8.41	8.25	8.28	8.10	8.08	8.15
Bacteriological Tests																
Coliform Bacteria - Fecal	-	-	<2	-	<2	-	-	<2	<2	-	<2	-	<2	<2	-	-
Coliform Bacteria - Total	-	-	7	-	4	-	-	<2	<2	-	<2	-	3	<2	-	-
Sterols																
Cholestanol	-	-	0.074	-	<0.050	-	-	<0.050	<0.15	-	<0.050	-	<0.050	0.066	-	-
Coprostanol	-	-	<0.050	-	<0.050	-	-	<0.050	<0.15	-	<0.050	-	<0.050	<0.050	-	-
Metals																
Antimony (Sb)	16.3	0.22	15.7	0.14	1.02	0.60	<0.10	0.10	0.24	<0.10	<0.10	0.25	0.22	2.45	1.05	3.08
Arsenic (As)	12.8	0.53	18.8	0.57	5.44	3.02	0.52	1.11	2.33	0.40	0.41	1.16	1.69	4.35	2.69	3.36
Barium (Ba)	171	73.4	355	106	437	244	126	134	208	95.4	107	138	202	274	230	169
Beryllium (Be)	0.15	0.11	0.36	<0.10	0.41	0.21	0.10	0.13	0.18	<0.10	<0.10	0.13	0.19	0.24	0.21	0.14
Cadmium (Cd)	50.6	0.382	30.1	0.149	2.39	1.52	0.096	0.171	0.791	<0.050	<0.050	0.217	0.416	5.83	2.09	7.31
Chromium (Cr)	7.83	7.18	21.5	4.68	21.8	12.0	6.24	6.53	10.4	5.00	4.95	6.52	9.69	12.4	11.3	7.84
Cobalt (Co)	5.48	3.22	10.6	2.75	10.1	5.89	3.09	3.19	5.24	2.56	2.76	3.40	4.58	6.15	5.61	4.07
Copper (Cu)	472	7.77	436	5.36	55.1	28.0	5.33	17.7	33.9	5.19	2.54	14.0	16.2	90.1	36.9	75.0
Lead (Pb)	14400	188	14100	82.4	840	547	34.7	80.1	223	7.18	6.88	338	195	2200	866	3030
Mercury (Hg)	20.9	0.122	12.7	0.0486	0.959	0.553	0.0254	0.106	0.404	0.0100	<0.0050	0.210	0.206	2.18	0.712	2.47
Molybdenum (Mo)	1.71	0.22	3.29	0.34	2.27	1.76	0.48	0.45	0.98	0.24	0.17	0.71	0.96	1.86	1.79	1.10
Nickel (Ni)	3.91	4.09	10.8	2.32	11.7	6.07	2.59	3.30	5.26	2.38	2.72	2.82	4.60	6.07	5.49	3.73
Selenium (Se)	0.74	<0.20	0.91	<0.20	0.28	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.22	<0.20	<0.20
Silver (Ag)	15.3	0.22	15.2	0.13	1.42	0.81	<0.10	0.11	0.34	<0.10	<0.10	0.34	0.25	2.31	1.02	3.32
Thallium (Tl)	2.36	0.098	2.48	0.097	0.473	0.269	0.091	0.106	0.188	0.069	0.078	0.126	0.196	0.531	0.345	0.568
Tin (Sn)	3.0	<2.0	4.2	<2.0	2.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium (U)	0.989	0.515	2.62	0.871	2.71	1.40	0.575	1.51	1.29	0.910	0.512	1.08	2.20	2.07	1.55	1.53
Vanadium (V)	26.4	20.6	67.4	20.2	71.8	39.3	23.2	23.4	37.9	17.7	19.0	26.0	34.2	42.8	40.3	27.8
Zinc (Zn)	33400	261	19400	120	1390	893	79.4	139	534	35.4	28.5	191	251	3730	1310	4610
Polycyclic Aromatic Hydrocarbons																
Acenaphthene	0.0228	-	0.0080	-	<0.030	0.0080	-	<0.0050	-	-	<0.0050	-	<0.0050	<0.0050	-	-
Acenaphthylene	0.0291	-	0.0397	-	0.0894	0.0320	-	0.0077	-	-	<0.0050	-	0.0165	0.0108	-	-
Anthracene	0.373	-	0.258	-	0.304	0.236	-	0.0171	-	-	<0.0040	-	0.0810	0.0261	-	-
Fluorene	0.146	-	0.175	-	0.074	0.094	-	<0.010	-	-	<0.010	-	0.011	<0.010	-	-
Naphthalene	<0.010	-	<0.010	-	0.012	<0.010	-	<0.010	-	-	<0.010	-	<0.010	<0.010	-	-
Phenanthrene	1.36	-	0.626	-	0.481	0.303	-	0.031	-	-	<0.010	-	0.084	0.051	-	-
2-Methylnaphthalene	<0.010	-	<0.010	-	<0.010	<0.010	-	<0.010	-	-	<0.010	-	<0.010	<0.010	-	-
Total LPAH	*1.9309*	-	*1.1067*	-	*0.9604*	*0.673*	-	*0.0558*	-	-	*N/A*	-	*0.1925*	*0.0879*	-	-
Benz(a)anthracene	2.37	-	2.21	-	1.36	1.14	-	0.045	-	-	<0.010	-	0.257	0.106	-	-
Benzo(a)pyrene	1.09	-	1.20	-	0.638	0.575	-	0.038	-	-	<0.010	-	0.165	0.102	-	-
Benzo(k)fluoranthene	0.958	-	0.893	-	0.707	0.508	-	0.037	-	-	<0.010	-	0.132	0.093	-	-
Benzo(b&j)fluoranthene	2.67	-	3.12	-	1.70	1.52	-	0.091	-	-	<0.010	-	0.343	0.260	-	-
Benzo(b+j+k)fluoranthene	3.63	-	4.02	-	2.4	2.03	-	0.128	-	-	<0.015	-	0.475	0.353	-	-
Benzo(g,h,i)perylene	0.302	-	0.266	-	0.156	0.144	-	0.011	-	-	<0.010	-	0.049	0.027	-	-
Chrysene	1.78	-	<2.0	-	1.27	1.23	-	0.061	-	-	<0.010	-	0.273	<0.20	-	-
Dibenz(a,h)anthracene	0.130	-	0.146	-	0.0703	0.0605	-	<0.0050	-	-	<0.0050	-	0.0188	0.0122	-	-
Fluoranthene	3.13	-	1.03	-	2.01	1.36	-	0.055	-	-	<0.010	-	0.432	0.131	-	-
Indeno(1,2,3-c,d)pyrene	0.407	-	0.356	-	0.201	0.196	-	0.014	-	-	<0.010	-	0.062	0.035	-	-
Pyrene	4.35	-	4.00	-	4.73	3.14	-	0.091	-	-	<0.010	-	0.606	0.402	-	-
Total HPAH	*17.189*	-	*13.228*	-	*12.835*	*9.876*	-	*0.443*	-	-	*N/A*	-	*2.338*	*1.168*	-	-
1-Methylnaphthalene	<0.050	-	<0.050	-	<0.050	<0.050	-	<0.050	-	-	<0.050	-	<0.050	<0.050	-	-
Quinoline	<0.050	-	<0.050	-	<0.050	<0.050	-	<0.050	-	-	<0.050	-	<0.050	<0.050	-	-

Notes:

AET : Apparent Effect Threshold
SCO : Sediment Cleanup Objective
CSL : Cleanup Screening Level
LPAH : Low Molecular Weight Polycyclic Aromatic Hydrocarbons
HPAH : High Molecular Weight Polycyclic Aromatic Hydrocarbons

1. Department of Egology, State of Washington, Sediment Cleanup Users Manual II, March 2015
2. The SCO represents the long-term sediment quality goal, while the CSL is the maximum chemical concentration or biological effects level allowed as a sediment cleanup level. They are used in conjunction for sediment risk management and remedial planning. The final sediment clean up level (i.e., the basis of design of remediation) is initially set at the more conservative SCO but can be adjusted upwards towards the CSL based on technical feasibility and net adverse environmental impacts as part of the selection of the remedial option.

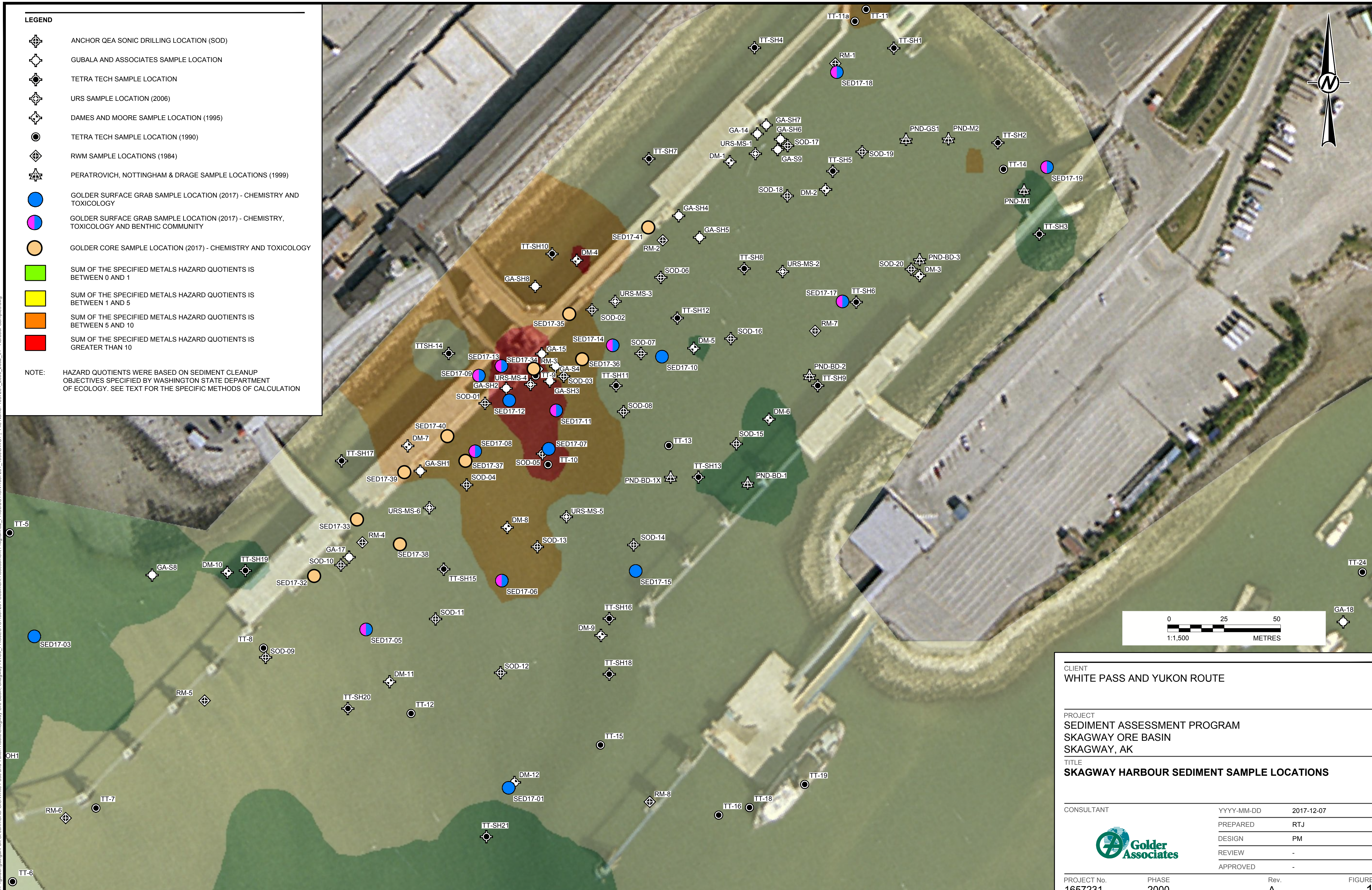
Value	Detected value is greater than marine sediment SCO
Value	Detected value is greater than marine sediment CSL
Value	Detection limit is greater than SCO/CSL
Value	Calculated parameter

"<" : Indicates parameter was below laboratory method detection limit.
"-" : Chemical not analyzed or criteria not defined.

Table A-2
Summary of Quality Assurance/Quality Control Analysis

Sample Name	SED17-34M	SED17-34M-DUP	Method Detection	Mean	Relative Percent	Difference Factor	SED17-41M	SED17-41M-DUP	Method Detection	Mean	Relative Percent	Difference Factor
Sample Date	31-Oct-2017	31-Oct-2017					31-Oct-2017	31-Oct-2017				
Sample Time	13:30	13:30					9:20	9:20				
Physical Tests												
Moisture (%)	25.8	26.3	0.25	26.1	1.9%	NA	23.4	-	0.25	NC	NC	NA
pH (1:2 soil:water)	8.51	8.60	0.1	8.6	1.1%	NA	8.10	8.08	0.1	8.1	0.2%	NA
Metals												
Antimony (Sb)	5.08	4.42	0.1	4.8	13.9%	NA	2.45	1.05	0.1	1.8	**80.0%**	NA
Arsenic (As)	7.79	6.64	0.1	7.2	15.9%	NA	4.35	2.69	0.1	3.5	**47.2%**	NA
Barium (Ba)	329	282	0.5	305.5	15.4%	NA	274	230	0.5	252.0	17.5%	NA
Beryllium (Be)	0.29	0.24	0.1	0.3	NA	0.5	0.24	0.21	0.1	0.2	NA	0.3
Cadmium (Cd)	12.8	9.82	0.05	11.3	26.3%	NA	5.83	2.09	0.05	4.0	**94.4%**	NA
Chromium (Cr)	16.9	14.6	0.5	15.8	14.6%	NA	12.4	11.3	0.5	11.9	9.3%	NA
Cobalt (Co)	7.86	6.79	0.1	7.3	14.6%	NA	6.15	5.61	0.1	5.9	9.2%	NA
Copper (Cu)	162	123	0.5	142.5	27.4%	NA	90.1	36.9	0.5	63.5	**83.8%**	NA
Lead (Pb)	4570	3280	0.5	3925.0	32.9%	NA	2200	866	0.5	1533.0	**87.0%**	NA
Mercury (Hg)	5.67	4.39	0.025	5.0	25.4%	NA	2.18	0.712	0.025	1.4	**101.5%**	NA
Molybdenum (Mo)	2.40	1.72	0.1	2.1	33.0%	NA	1.86	1.79	0.1	1.8	3.8%	NA
Nickel (Ni)	8.39	7.45	0.5	7.9	11.9%	NA	6.07	5.49	0.5	5.8	10.0%	NA
Selenium (Se)	0.33	0.24	0.2	0.3	NA	0.5	0.22	<0.20	0.2	0.2	NA	NA
Silver (Ag)	5.21	3.99	0.1	4.6	26.5%	NA	2.31	1.02	0.1	1.7	**77.5%**	NA
Thallium (Tl)	0.956	0.726	0.05	0.8	27.3%	NA	0.531	0.345	0.05	0.4	**42.5%**	NA
Tin (Sn)	3.6	6.9	2	5.3	NA	1.7	<2.0	<2.0	2	NC	NC	NA
Uranium (U)	1.86	1.76	0.05	1.8	5.5%	NA	2.07	1.55	0.05	1.8	28.7%	NA
Vanadium (V)	52.0	45.0	0.2	48.5	14.4%	NA	42.8	40.3	0.2	41.6	6.0%	NA
Zinc (Zn)	8240	6180	2	7210.0	28.6%	NA	3730	1310	2	2520.0	**96.0%**	NA
Polycyclic Aromatic Hydrocarbons												
Acenaphthene	0.142	0.149	0.005	0.1	4.8%	NA	<0.0050	-	0.005	NC	NC	NA
Acenaphthylene	0.0888	0.0686	0.005	0.1	25.7%	NA	0.0108	-	0.005	NC	NC	NA
Anthracene	1.58	0.728	0.004	1.2	**73.8%**	NA	0.0261	-	0.004	NC	NC	NA
Fluorene	0.62	0.448	0.01	0.5	32.7%	NA	<0.010	-	0.01	NC	NC	NA
Naphthalene	0.015	0.019	0.01	0.0	NA	0.4	<0.010	-	0.01	NC	NC	NA
Phenanthrene	2.02	1.20	0.01	1.6	**50.9%**	NA	0.051	-	0.01	NC	NC	NA
2-Methylnaphthalene	0.020	0.017	0.01	0.0	NA	0.3	<0.010	-	0.01	NC	NC	NA
Benz(a)anthracene	8.09	4.48	0.01	6.3	**57.4%**	NA	0.106	-	0.01	NC	NC	NA
Benzo(a)pyrene	2.85	1.89	0.01	2.4	**40.5%**	NA	0.102	-	0.01	NC	NC	NA
Benzo(k)fluoranthene	3.08	1.67	0.01	2.4	**59.4%**	NA	0.093	-	0.01	NC	NC	NA
Benzo(b&j)fluoranthene	8.79	5.67	0.01	7.2	**43.2%**	NA	0.260	-	0.01	NC	NC	NA
Benzo(b+j+k)fluoranthene	11.90	7.34	0.015	9.6	**47.4%**	NA	0.353	-	0.015	NC	NC	NA
Benzo(g,h,i)perylene	0.554	0.402	0.01	0.5	31.8%	NA	0.027	-	0.01	NC	NC	NA
Chrysene	6.94	<3.0	3	6.9	NA	NA	<0.20	-	0.01	NC	NC	NA
Dibenz(a,h)anthracene	0.370	0.223	0.005	0.3	**49.6%**	NA	0.0122	-	0.005	NC	NC	NA
Fluoranthene	15.8	10.1	0.01	13.0	**44.0%**	NA	0.131	-	0.01	NC	NC	NA
Indeno(1,2,3-c,d)pyrene	0.706	0.490	0.01	0.6	**36.1%**	NA	0.035	-	0.01	NC	NC	NA
Pyrene	11.6	8.32	0.01	10.0	32.9%	NA	0.402	-	0.01	NC	NC	NA
1-Methylnaphthalene	<0.050	<0.050	0.05	NC	NC	NA	<0.050	-	0.05	NC	NC	NA
Quinoline	<0.050	<0.050	0.05	NC	NC	NA	<0.050	-	0.05	NC	NC	NA

Notes:
Results expressed in milligrams per kilogram (mg/kg), unless otherwise indicated.
Method Detection Limit indicates the minimum concentration that could be measured by laboratory instrumentation for a specific sample.
Mean indicates the mean or average value calculated for a field duplicate pair (the FDA and the FD).
Relative Percent Difference is calculated when the mean value is greater than five times the method detection limit; Golder's internal QA/QC target is less than 35%.
Difference Factor is calculated when the mean value is less than five times the method detection limit; Golder's internal QA/QC target is less than 2.
QA/QC = quality assurance/quality control
"-" = Not analysed; NC = Not Calculated; NA = not applicable
BOLD font indicates the parameter analysed exceeds Golder's internal QA/QC targets.



CLIENT
WHITE PASS AND YUKON ROUTE

PROJECT
SEDIMENT ASSESSMENT PROGRAM
SKAGWAY ORE BASIN
SKAGWAY, AK

TITLE
SKAGWAY HARBOUR SEDIMENT SAMPLE LOCATIONS

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-12-07
PREPARED	RTJ
DESIGN	PM
REVIEW	-
APPROVED	-

PROJECT No.	PHASE	Rev.	FIGURE
1657231	2000	A	1

25 mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

APPENDIX A

Sediment Borehole Logs

PROJECT No.: 1657231 / 2000 / 2200

RECORD OF SEDIMENT CORE: SED17-32

SHEET 1 OF 1

DATUM: NAD 83 Zone 8V

CLIENT: White Pass and Yukon Route
PROJECT: Skagway Ore Basin Drilling Program
LOCATION: Skagway Harbour
N: 21621237.6 E: 1579248.7

DRILLING DATE: October 28, 2017
DRILLING CONTRACTOR: AquaSource LLC

INCLINATION: -90°

DEPTH SCALE FEET	DRILLING RIG	DRILLING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	GEOTECH SAMPLES: NUMBER	TYPE	BLOWS/ft	CORE No.	CORE RECOVERY %	CHEMISTRY SAMPLES: NUMBER	SCN	ANALYSED	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft 20 40 60 80; WATER CONTENT % Wp W Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
			Below Mean Sea Level		-37.60											
0	Truck Mounted Air Rotary	Direct Push	**(OL)** Organic mud and silt		0.00											
2							SS				32S	7977-01				
			(SP) Coarse sand, some gravel		-40.10 2.50											
4							SS				32M	7977-02				
6																
			End of Sediment Core.		-44.60 7.00											
8																
10																

DEPTH SCALE

1 in to 1 ft

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: EH

CHECKED: TR

PROJECT No.: 1657231 / 2000 / 2200

RECORD OF SEDIMENT CORE: SED17-33

SHEET 1 OF 1

CLIENT: White Pass and Yukon Route
PROJECT: Skagway Ore Basin Drilling Program
LOCATION: Skagway Harbour
N: 21621310.1 E: 1579320.5

DATUM: NAD 83 Zone 8V

DRILLING DATE: October 28, 2017
DRILLING CONTRACTOR: AquaSource LLC

INCLINATION: -90°

DEPTH SCALE FEET	DRILLING RIG	DRILLING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	GEOTECH SAMPLES NUMBER	TYPE	BLOWS/ft	CORE No.	CORE RECOVERY %	CHEMISTRY SAMPLES NUMBER	SCN	ANALYSED	⊕ 0 0 0 0	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft 20 40 60 80; WATER CONTENT % Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0	Truck Mounted Air Rotary	Direct Push	Below Mean Sea Level		-37.50												
			(OH) Organic mud		0.00												
2							SS				33S	7977-03					
					-40.00												
			(SM) Silt and fine sand		2.50												
					-41.00												
			(SP) Coarse sand, some gravel		3.50												
4												7977-04					
							SS				33M						
					-43.50												
6			End of Sediment Core.		6.00												
8																	
10																	

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form:BC_BOREHOLE (GEO/ENVIRO) RYJames 16/7/18

DEPTH SCALE

1 in to 1 ft

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: EH

CHECKED: TR

PROJECT No.: 1657231 / 2000 / 2200

RECORD OF SEDIMENT CORE: SED17-34

SHEET 1 OF 1

CLIENT: White Pass and Yukon Route
PROJECT: Skagway Ore Basin Drilling Program
LOCATION: Skagway Harbour
N: 21621371.3 E: 1579395.0

DATUM: NAD 83 Zone 8V

DRILLING DATE: October 31, 2017
DRILLING CONTRACTOR: AquaSource LLC

INCLINATION: -90°

DEPTH SCALE FEET	DRILLING RIG	DRILLING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (ft)	GEOTECH SAMPLES: NUMBER	TYPE	BLOWS/ft	CORE No.	CORE RECOVERY %	CHEMISTRY SAMPLES: NUMBER	SCN	ANALYSED	0 0 0 0 ⊕	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft 20 40 60 80; WATER CONTENT % Wp W Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
			Below Mean Sea Level		-38.40												
0	Truck Mounted Air Rotary	Direct Push	**(OH)** Organic mud		0.00												
2																	
4							SS				34S	7979-04					
					-43.90 / 5.50												
			(SM) Silt and fine sand		-44.10 / 5.70		SS				34M	7979-02					
6			**(SP)** Coarse sand, some gravel				SS				34D	7979-03					
8					-46.40 / 8.00												
			End of Sediment Core.														
10																	

DEPTH SCALE
1 in to 1 ft

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS
LOGGED: ER
CHECKED: TR

PROJECT No.: 1657231 / 2000 / 2200

RECORD OF SEDIMENT CORE: SED17-35

DATUM: NAD 83 Zone 8V

CLIENT: White Pass and Yukon Route
PROJECT: Skagway Ore Basin Drilling Program
LOCATION: Skagway Harbour
N: 21621432.3 E: 1579452.7

DRILLING DATE: October 31, 2017
DRILLING CONTRACTOR: AquaSource LLC

INCLINATION: -90°

DEPTH SCALE FEET	DRILLING RIG	DRILLING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (ft)	GEOTECH SAMPLES: NUMBER	TYPE	BLOWS/ft	CORE No.	CORE RECOVERY %	CHEMISTRY SAMPLES: NUMBER	SCN	ANALYSED	⊕ 0 0 0 0	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft 20 40 60 80; WATER CONTENT % Wp ⊢ W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
			Below Mean Sea Level		-38.00												
0	Truck Mounted Air Rotary	Direct Push	**(OH)** Organic mud		0.00												
2																	
4																	
6							SS				35S	7979-07					
					-44.50 / 6.50												
			(SM) Silt and fine sand				SS				35M	7979-06					
					-45.70 / 7.70												
8			**(SP)** Coarse sand, some gravel				SS				35D	7979-08					
					-47.00 / 9.00												
			End of Sediment Core.														
10																	

DEPTH SCALE
1 in to 1 ft

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS
LOGGED: ER
CHECKED: TR

PROJECT No.: 1657231 / 2000 / 2200

RECORD OF SEDIMENT CORE: SED17-36

SHEET 1 OF 1

CLIENT: White Pass and Yukon Route
PROJECT: Skagway Ore Basin Drilling Program
LOCATION: Skagway Harbour
N: 21621538.7 E: 1579567.7

DATUM: NAD 83 Zone 8V

DRILLING DATE: October 30, 2017
DRILLING CONTRACTOR: AquaSource LLC

INCLINATION: -90°

DEPTH SCALE FEET	DRILLING RIG	DRILLING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (ft)	GEOTECH SAMPLES: NUMBER	TYPE	BLOWS/ft	CORE No.	CORE RECOVERY %	CHEMISTRY SAMPLES: NUMBER	SCN	ANALYSED	⊕ 0 0 0 0	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft 20 40 60 80 / WATER CONTENT % Wp —○W— Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
			Below Mean Sea Level		-38.70												
0	Truck Mounted Air Rotary	Direct Push	**(OH)** Organic mud		0.00												
4							SS				36S	7980-01					
					-43.70 / 5.00												
			(SM) Silt and fine sand				SS				36M	7979-12					
					-44.20 / 5.50												
			(SP) Coarse sand, some gravel														
6							SS				36D	7980-02					
					-47.70 / 9.00												
			End of Sediment Core.														
10																	

DEPTH SCALE
1 in to 1 ft

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS
LOGGED: ER
CHECKED: TR

PROJECT No.: 1657231 / 2000 / 2200

RECORD OF SEDIMENT CORE: SED17-37

SHEET 1 OF 1

CLIENT: White Pass and Yukon Route
PROJECT: Skagway Ore Basin Drilling Program
LOCATION: Skagway Harbour
N: 21621603.6 E: 1579628.1

DATUM: NAD 83 Zone 8V

DRILLING DATE: October 30, 2017
DRILLING CONTRACTOR: AquaSource LLC

INCLINATION: -90°

DEPTH SCALE FEET	DRILLING RIG	DRILLING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	GEOTECH SAMPLES: NUMBER	TYPE	BLOWS/ft	CORE No.	CORE RECOVERY %	CHEMISTRY SAMPLES: NUMBER	SCN	ANALYSED	⊕ 0 0 0 0	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft 20 40 60 80; WATER CONTENT % Wp W Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
			Below Mean Sea Level		-37.80												
0	Truck Mounted Air Rotary	Direct Push	**(OL)** Organic mud and silt		0.00												
							SS				37M	7978-04					
					-43.30												
			(SP) Coarse sand, some gravel		5.50												
							SS				37D	7978-03					
					-45.80												
8			End of Sediment Core.		8.00												

DEPTH SCALE

1 in to 1 ft

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: ER

CHECKED: TR

PROJECT No.: 1657231 / 2000 / 2200

RECORD OF SEDIMENT CORE: SED17-38

SHEET 1 OF 1

CLIENT: White Pass and Yukon Route
PROJECT: Skagway Ore Basin Drilling Program
LOCATION: Skagway Harbour
N: 21621728.6 E: 1579746.0

DATUM: NAD 83 Zone 8V

DRILLING DATE: October 31, 2017
DRILLING CONTRACTOR: AquaSource LLC

INCLINATION: -90°

DEPTH SCALE FEET	DRILLING RIG	DRILLING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (ft)	GEOTECH NUMBER	TYPE	BLOWS/ft	CORE No.	CORE RECOVERY %	CHEMISTRY NUMBER	SCN	ANALYSED	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft / WATER CONTENT %	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
			Below Mean Sea Level		-38.20											
0	Truck Mounted Air Rotary	Direct Push	**(OH)** Organic mud		0.00											
6							SS				38S	7979-09				
			(SM) Silt and fine sand		-44.90 / 6.70		SS				38M	7979-10				
			(SP) Coarse sand, some gravel		-45.40 / 7.20											
8							SS				38D	7979-11				
			End of Sediment Core.		-47.20 / 9.00											
10																

DYNAMIC PENETRATION RESISTANCE, BLOWS/ft: 20 40 60 80
WATER CONTENT %: Wp W Wl — 10 20 30 40

DEPTH SCALE
1 in to 1 ft

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS
LOGGED: ER
CHECKED: TR

PROJECT No.: 1657231 / 2000 / 2200

RECORD OF SEDIMENT CORE: SED17-39

SHEET 1 OF 1

DATUM: NAD 83 Zone 8V

CLIENT: White Pass and Yukon Route
PROJECT: Skagway Ore Basin Drilling Program
LOCATION: Skagway Harbour
N: 21621269.4 E: 1579387.5

DRILLING DATE: October 31, 2017
DRILLING CONTRACTOR: AquaSource LLC

INCLINATION: -90°

DEPTH SCALE FEET	DRILLING RIG	DRILLING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (ft)	GEOTECH SAMPLES: NUMBER	TYPE	BLOWS/ft	CORE No.	CORE RECOVERY %	CHEMISTRY SAMPLES: NUMBER	SCN	ANALYSED	⊕ 0 0 0 0	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft 20 40 60 80 / WATER CONTENT % Wp W Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
			Below Mean Sea Level		-42.04												
0	Truck Mounted Air Rotary	Direct Push	**(SP)** Sand		0.00												
					-43.14		SS				39S	7979-01					
			(SM) Silt and fine sand		1.10												
							SS				39M	7978-12					
					-43.64												
			(SP) Coarse sand, some gravel		1.60												
2							SS				39D	7978-11					
					-45.04												
			End of Sediment Core.		3.00												
4																	
6																	
8																	
10																	

DEPTH SCALE

1 in to 1 ft

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: ER

CHECKED: TR

PROJECT No.: 1657231 / 2000 / 2200

CLIENT: White Pass and Yukon Route
PROJECT: Skagway Ore Basin Drilling Program
LOCATION: Skagway Harbour
N: 21621380.8 E: 1579496.1

RECORD OF SEDIMENT CORE: SED17-40

DRILLING DATE: October 31, 2017
DRILLING CONTRACTOR: AquaSource LLC

INCLINATION: -90°

SHEET 1 OF 1

DATUM: NAD 83 Zone 8V

DEPTH SCALE FEET	DRILLING RIG	DRILLING METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (ft)	GEOTECH SAMPLES – NUMBER	TYPE	BLOWS/ft	CORE No.	CORE RECOVERY %	CHEMISTRY SAMPLES – NUMBER	SCN	ANALYSED	0 0 0 0 ⊕	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft (20 40 60 80); WATER CONTENT % Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
			Below Mean Sea Level		-40.80												
0	Truck Mounted Air Rotary	Direct Push	**(SM)** Silt and fine sand		0.00												
2							SS				40M	7978-09					
			(SP) Coarse sand, some gravel		-43.10												
							SS				40D	7978-10					
4																	
					-45.80 / 5.00												
			End of Sediment Core.														
6																	
8																	
10																	

DEPTH SCALE

1 in to 1 ft

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: ER

CHECKED: TR

PROJECT No.: 1657231 / 2000 / 2200

RECORD OF SEDIMENT CORE: SED17-41

SHEET 1 OF 1

CLIENT: White Pass and Yukon Route
PROJECT: Skagway Ore Basin Drilling Program
LOCATION: Skagway Harbour
N: 21621534.9 E: 1579662.4

DATUM: NAD 83 Zone 8V

DRILLING DATE: October 31, 2017
DRILLING CONTRACTOR: AquaSource LLC

INCLINATION: -90°

DEPTH SCALE FEET	DRILLING RIG	DRILLING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (ft)	GEOTECH SAMPLES: NUMBER	TYPE	BLOWS/ft	CORE No.	CORE RECOVERY %	CHEMISTRY SAMPLES: NUMBER	SCN	ANALYSED	⊕ 0 0 0 0	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft 20 40 60 80; WATER CONTENT % Wp W Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
			Below Mean Sea Level		-40.40												
0	Truck Mounted Air Rotary	Direct Push	**(SP)** Sand		0.00		SS				41S	7978-07					
			(SM) Silt and fine sand		-40.65 / 0.25		SS				41M	7978-06					
			(SP) Coarse sand, some gravel		-41.40 / 1.00												
2							SS				41D	7978-05					
4			End of Sediment Core.		-44.40 / 4.00												
6																	
8																	
10																	

DEPTH SCALE

1 in to 1 ft

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: ER

CHECKED: TR

APPENDIX B

Photographic Log

Photo 1: Drill rig boarding the landing craft at the Skagway harbour.

Photo 2: Sample location SED17-32 looking southwest.

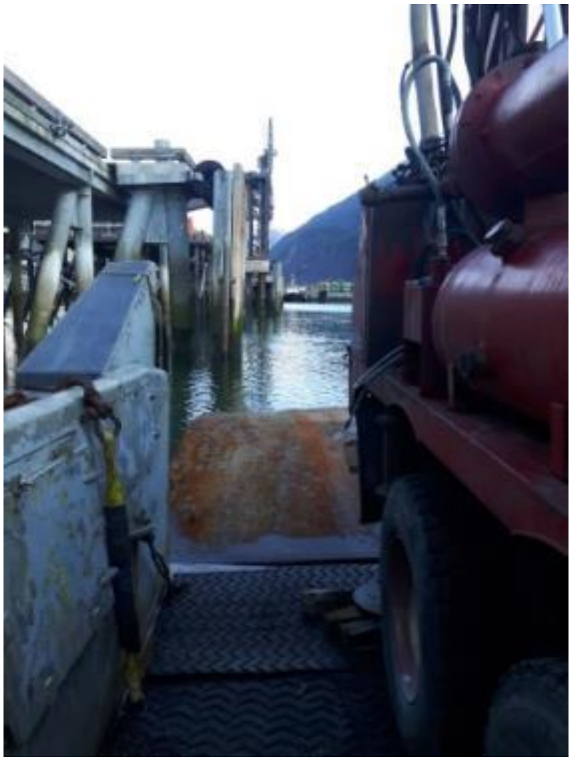


Photo 3: Sample location SED17-32 looking southwest.

Photo 4: Core recovered at sample location SED17-32.

Photo 5: Sample location SED17-41 relative to ship loader

Photo 6: Sample location SED17-41, core recovered in the 4th spoon.

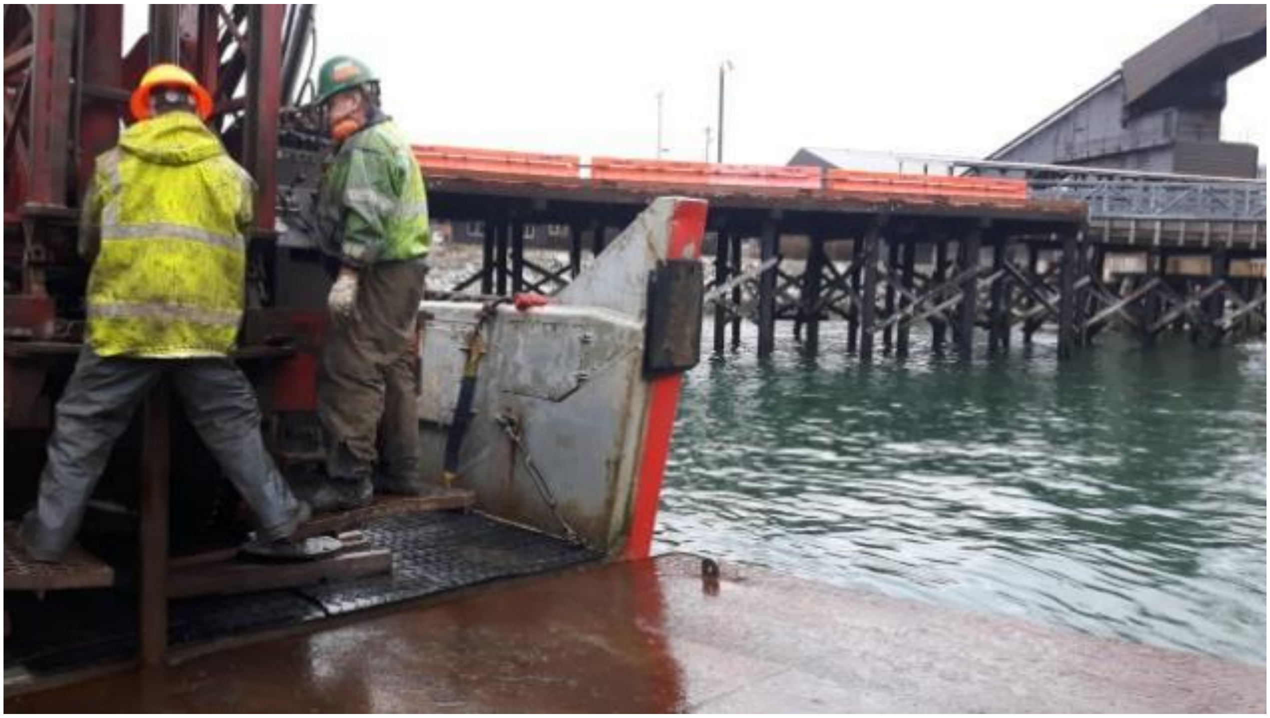


Photo 7: Sample location SED17-40 relative to ship loader.

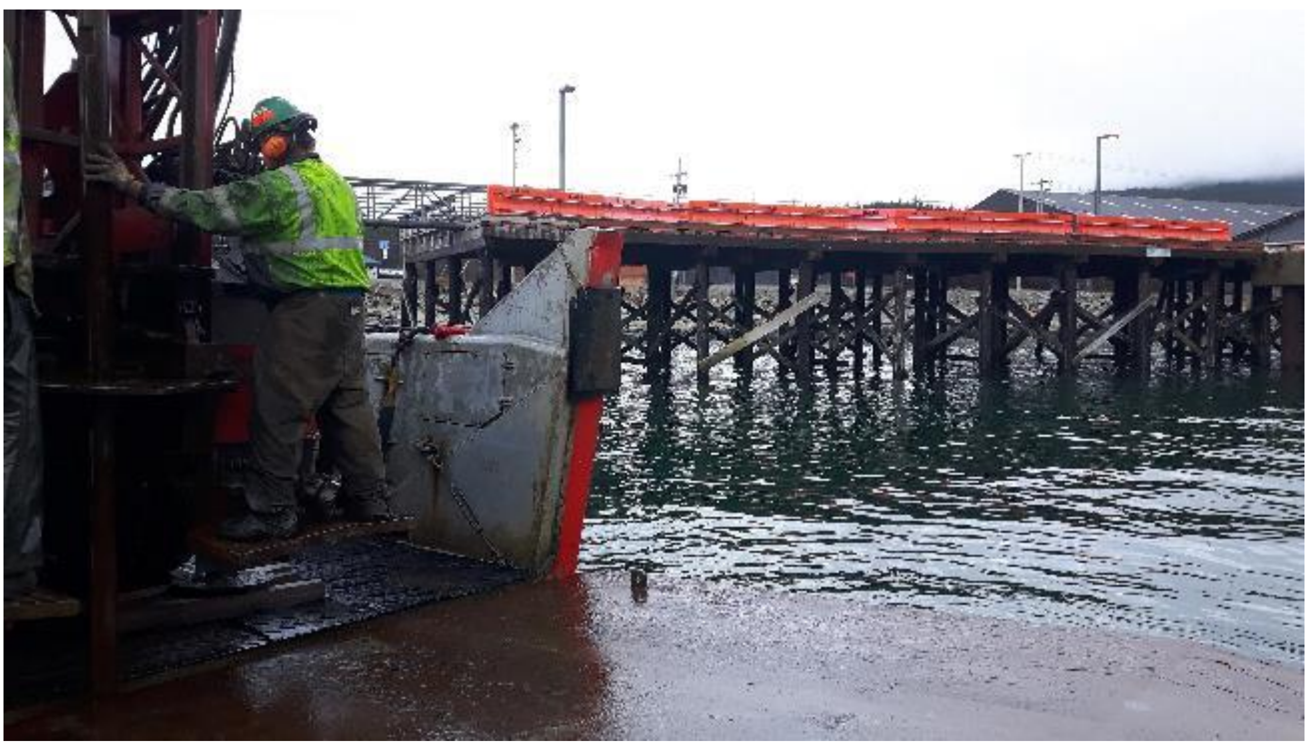


Photo 8: Sample location SED17-39 relative to wharf infrastructures.

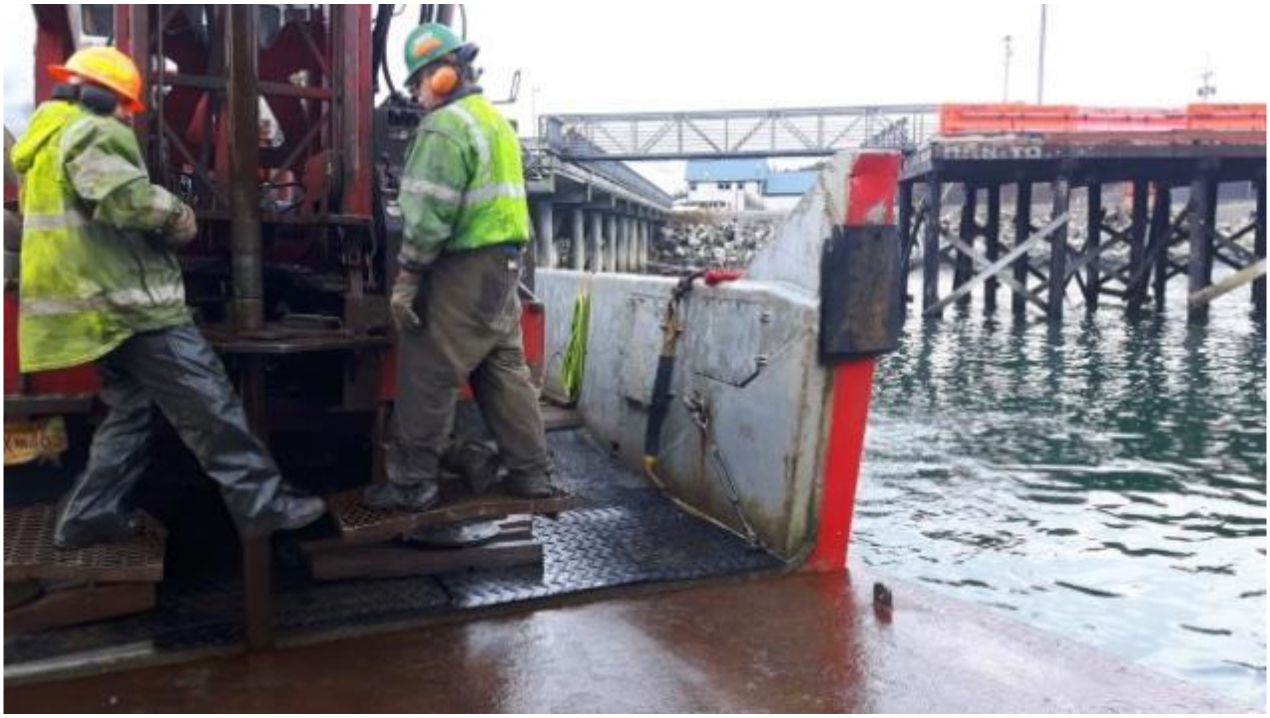


Photo 9: Sample location SED17-39 relative to metal walkway.

Photo 10: Sample location SED17-39, samples SED17-39M (SCN 7978-12) and SED17-39D (SCN 7978-11).

Photo 11: Sample location SED17-34 relative to wharf.

Photo 12: Sample location SED17-34, core recovered in the 3rd spoon

Photo 13: Sample location SED17-35, core recovered in the 1st spoon.

Photo 14: Sample location SED17-35 relative to wharf and ship loader.

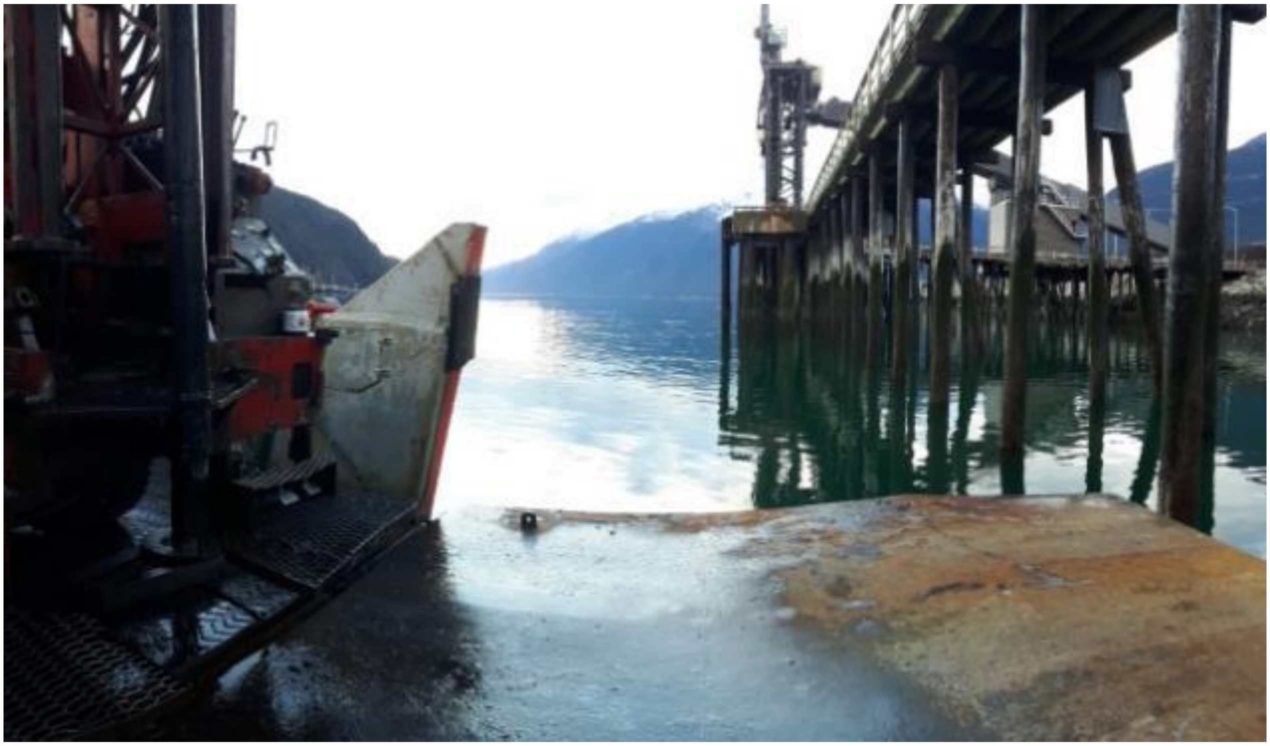


Photo 15: Sample location SED17-38 relative to wharf and ship loader.

Photo 16: Sample location SED17-38, core recovered in the 2nd spoon; obvious difference in sediment classifications.

Photo 17: Sample location SED17-37 relative to ship loader.

Photo 18: Sample location SED17-37, core recovered in the 4th spoon.

Photo 19: Sample location SED17-33 relative to wharf and ship loader.

Photo 20: Sample location SED17-33, core recovered in the 1st spoon.

APPENDIX C

Laboratory Certificates of Analysis and Alaska DEC QA Checklists

GOLDER ASSOCIATES LTD.
ATTN: Tamra Reynolds
203, 170 Titanium Way
Whitehorse YT Y1A 0G1

Date Received: 30-OCT-17
Report Date: 24-NOV-17 10:42 (MT)
Version: FINAL

Client Phone: 867-633-6076

Certificate of Analysis

Lab Work Order #: L2015183

Project P.O. #: NOT SUBMITTED
Job Reference: 1657231
C of C Numbers: 07977
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2015183-1	L2015183-2	L2015183-3	L2015183-4	
	Description	SE	SE	SE	SE	
	Sampled Date	28-OCT-17	28-OCT-17	28-OCT-17	28-OCT-17	
	Sampled Time	14:50	14:50	18:30	18:30	
	Client ID	7977-01	7977-02	7977-03	7977-04	
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	23.8	17.7	24.1	22.6	
	pH (1:2 soil:water) (pH)	8.58	8.65	8.57	8.59	
Bacteriological Tests	Coliform Bacteria - Fecal (MPN/g)	<2	<2	<2	<2	
	Coliform Bacteria - Total (MPN/g)	4	4	3	3	
Metals	Antimony (Sb) (mg/kg)	0.12	0.11	0.17	0.63	
	Arsenic (As) (mg/kg)	1.95	1.09	2.31	1.87	
	Barium (Ba) (mg/kg)	210	135	192	168	
	Beryllium (Be) (mg/kg)	0.20	0.12	0.17	0.17	
	Cadmium (Cd) (mg/kg)	0.296	0.183	0.411	0.901	
	Chromium (Cr) (mg/kg)	11.2	6.53	18.9	9.16	
	Cobalt (Co) (mg/kg)	5.17	3.38	5.01	4.17	
	Copper (Cu) (mg/kg)	33.1	11.3	43.4	32.4	
	Lead (Pb) (mg/kg)	57.9	72.5	159	705	
	Mercury (Hg) (mg/kg)	0.075	0.074	0.136	0.428	
	Molybdenum (Mo) (mg/kg)	1.00	0.48	0.97	1.59	
	Nickel (Ni) (mg/kg)	6.04	3.13	8.22	4.22	
	Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	
	Silver (Ag) (mg/kg)	0.13	0.10	0.21	0.72	
	Thallium (Tl) (mg/kg)	0.179	0.114	0.179	0.205	
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	
	Uranium (U) (mg/kg)	1.37	1.09	1.36	1.39	
	Vanadium (V) (mg/kg)	37.9	24.8	34.0	30.5	
	Zinc (Zn) (mg/kg)	165	141	231	555	
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050		<0.050		
	Acenaphthylene (mg/kg)	<0.050		<0.050		
	Anthracene (mg/kg)	<0.050		0.069		
	Benz(a)anthracene (mg/kg)	0.112		0.237		
	Benzo(a)pyrene (mg/kg)	0.074		0.109		
	Benzo(b&j)fluoranthene (mg/kg)	0.186		0.250		
	Benzo(g,h,i)perylene (mg/kg)	<0.050		<0.050		
	Benzo(k)fluoranthene (mg/kg)	0.073		0.097		
	Chrysene (mg/kg)	0.289		0.287		
	Dibenz(a,h)anthracene (mg/kg)	<0.050		<0.050		
	Fluoranthene (mg/kg)	0.177		0.503		
	Fluorene (mg/kg)	<0.050		<0.050		
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050		<0.050		

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2015183-1 SE 28-OCT-17 14:50 7977-01	L2015183-2 SE 28-OCT-17 14:50 7977-02	L2015183-3 SE 28-OCT-17 18:30 7977-03	L2015183-4 SE 28-OCT-17 18:30 7977-04	
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	1-Methylnaphthalene (mg/kg)	<0.050		<0.050		
	2-Methylnaphthalene (mg/kg)	<0.050		<0.050		
	Naphthalene (mg/kg)	<0.050		<0.050		
	Phenanthrene (mg/kg)	0.098		0.148		
	Pyrene (mg/kg)	0.311		0.614		
	Quinoline (mg/kg)	<0.050		<0.050		
	Surrogate: Acenaphthene d10 (%)	86.5		89.6		
	Surrogate: Chrysene d12 (%)	107.3		107.2		
	Surrogate: Naphthalene d8 (%)	89.1		93.3		
	Surrogate: Phenanthrene d10 (%)	102.5		104.3		
	B(a)P Total Potency Equivalent (mg/kg)	0.126		0.187		
	IACR (CCME) (mg/kg)	2.35		3.39		
Miscellaneous	Cholestanol (mg/kg)	0.099	<0.050	0.415		
	Coprostanol (mg/kg)	<0.050	<0.050	0.062		

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
FCOLI-DRY-MTF-VA	Soil	Fecal coliform by MPN	EPA Method 1680

This analysis is carried out using procedures adapted from EPA Method 1680 "Fecal Coliforms in Sewage Sludge (Biosolids) by Multiple Tube Fermentation using Lauryl Tryptose Broth (LTB) and EC medium". Serial dilutions of the sample are incubated with the appropriate growth medium, and fecal coliforms are quantified by a statistical estimation of bacteria density (most probable number). The test involves initial 48 hour incubation (presumptive test), positive results are further tested (up to an additional 24 hours) to confirm and quantify fecal coliforms.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

This method uses a heated strong acid digestion with HNO3 and HCl and is intended to liberate metals that may be environmentally available. Silicate minerals are not solubilized. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. Analysis is by Collision/Reaction Cell ICPMS.

MOISTURE-VA	Soil	Moisture content	CWS for PHC in Soil - Tier 1

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

PAH-TMB-H/A-MS-VA	Soil	PAH - Rotary Extraction (Hexane/Acetone)	EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

STEROLS-SOX-MS-VA	Soil	Sterols by GCMS	EPA 3570 & 8270 / J. OF CHROM. 1108
TCOLI-DRY-MTF-VA	Soil	Total coliform by MPN	TMECC 07.00 PATHOGENS

This analysis is carried out using procedures adapted from TMECC 07.00 PATHOGENS. This method describes multiple-tube fermentation technique for the detection and enumeration of total coliforms. Serial dilutions of the sample are incubated with the appropriate growth medium, and total coliforms are quantified by a statistical estimation of bacteria density (most probable number). The test involves initial 48 hour incubation (presumptive test); positive results do not require further testing for confirmation of total coliforms.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

07977

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: GOLDER ASSOCIATES LTD.
203, 170 Titanium Way
Whitehorse YT Y1A 0G1

Contact: Tamra Reynolds

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
FCOLI-DRY-MTF-VA	**Soil**							
Batch R3873245								
WG2652201-1 DUP		**L2015183-4**						
Coliform Bacteria - Fecal		<2	<2	RPD-NA	MPN/g	N/A	65	30-OCT-17
WG2652201-2 MB								
Coliform Bacteria - Fecal			<2		MPN/g		2	30-OCT-17
HG-200.2-CVAF-VA	**Soil**							
Batch R3872797								
WG2653362-4 CRM		**VA-CANMET-TILL1**						
Mercury (Hg)			96.9		%		70-130	02-NOV-17
WG2653362-3 LCS								
Mercury (Hg)			102.9		%		70-130	02-NOV-17
WG2653362-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	02-NOV-17
Batch R3875281								
WG2655767-4 CRM		**VA-CANMET-TILL1**						
Mercury (Hg)			95.0		%		70-130	05-NOV-17
WG2655767-3 LCS								
Mercury (Hg)			104.7		%		70-130	05-NOV-17
WG2655767-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	05-NOV-17
MET-200.2-CCMS-VA	**Soil**							
Batch R3874008								
WG2653362-4 CRM		**VA-CANMET-TILL1**						
Antimony (Sb)			106.9		%		70-130	02-NOV-17
Arsenic (As)			102.3		%		70-130	02-NOV-17
Barium (Ba)			101.2		%		70-130	02-NOV-17
Beryllium (Be)			0.55		mg/kg		0.34-0.74	02-NOV-17
Cadmium (Cd)			96.0		%		70-130	02-NOV-17
Chromium (Cr)			109.3		%		70-130	02-NOV-17
Cobalt (Co)			103.7		%		70-130	02-NOV-17
Copper (Cu)			103.3		%		70-130	02-NOV-17
Lead (Pb)			97.9		%		70-130	02-NOV-17
Molybdenum (Mo)			99.0		%		70-130	02-NOV-17
Nickel (Ni)			105.3		%		70-130	02-NOV-17
Selenium (Se)			0.36		mg/kg		0.11-0.51	02-NOV-17
Silver (Ag)			0.24		mg/kg		0.13-0.33	02-NOV-17
Thallium (Tl)			0.125		mg/kg		0.077-0.18	02-NOV-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R3874008								
WG2653362-4 CRM		**VA-CANMET-TILL1**						
Tin (Sn)			1.1		mg/kg		0-3	02-NOV-17
Uranium (U)			102.5		%		70-130	02-NOV-17
Vanadium (V)			108.3		%		70-130	02-NOV-17
Zinc (Zn)			103.2		%		70-130	02-NOV-17
WG2653362-3 LCS								
Antimony (Sb)			101.3		%		80-120	02-NOV-17
Arsenic (As)			94.5		%		80-120	02-NOV-17
Barium (Ba)			104.5		%		80-120	02-NOV-17
Beryllium (Be)			99.7		%		80-120	02-NOV-17
Cadmium (Cd)			100.8		%		80-120	02-NOV-17
Chromium (Cr)			103.6		%		80-120	02-NOV-17
Cobalt (Co)			99.98		%		80-120	02-NOV-17
Copper (Cu)			101.3		%		80-120	02-NOV-17
Lead (Pb)			99.8		%		80-120	02-NOV-17
Molybdenum (Mo)			91.1		%		80-120	02-NOV-17
Nickel (Ni)			101.7		%		80-120	02-NOV-17
Selenium (Se)			96.3		%		80-120	02-NOV-17
Silver (Ag)			102.4		%		80-120	02-NOV-17
Thallium (Tl)			99.3		%		80-120	02-NOV-17
Tin (Sn)			93.6		%		80-120	02-NOV-17
Uranium (U)			102.9		%		80-120	02-NOV-17
Vanadium (V)			103.7		%		80-120	02-NOV-17
Zinc (Zn)			92.3		%		80-120	02-NOV-17
WG2653362-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	02-NOV-17
Arsenic (As)			<0.10		mg/kg		0.1	02-NOV-17
Barium (Ba)			<0.50		mg/kg		0.5	02-NOV-17
Beryllium (Be)			<0.10		mg/kg		0.1	02-NOV-17
Cadmium (Cd)			<0.020		mg/kg		0.02	02-NOV-17
Chromium (Cr)			<0.50		mg/kg		0.5	02-NOV-17
Cobalt (Co)			<0.10		mg/kg		0.1	02-NOV-17
Copper (Cu)			<0.50		mg/kg		0.5	02-NOV-17
Lead (Pb)			<0.50		mg/kg		0.5	02-NOV-17
Molybdenum (Mo)			<0.10		mg/kg		0.1	02-NOV-17
Nickel (Ni)			<0.50		mg/kg		0.5	02-NOV-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R3874008								
WG2653362-1 MB								
Selenium (Se)			<0.20		mg/kg		0.2	02-NOV-17
Silver (Ag)			<0.10		mg/kg		0.1	02-NOV-17
Thallium (Tl)			<0.050		mg/kg		0.05	02-NOV-17
Tin (Sn)			<2.0		mg/kg		2	02-NOV-17
Uranium (U)			<0.050		mg/kg		0.05	02-NOV-17
Vanadium (V)			<0.20		mg/kg		0.2	02-NOV-17
Zinc (Zn)			<2.0		mg/kg		2	02-NOV-17
Batch R3875567								
WG2655767-3 LCS								
Antimony (Sb)			100.7		%		80-120	05-NOV-17
Arsenic (As)			99.9		%		80-120	05-NOV-17
Barium (Ba)			100.1		%		80-120	05-NOV-17
Beryllium (Be)			94.9		%		80-120	05-NOV-17
Cadmium (Cd)			102.9		%		80-120	05-NOV-17
Chromium (Cr)			97.4		%		80-120	05-NOV-17
Cobalt (Co)			99.4		%		80-120	05-NOV-17
Copper (Cu)			101.2		%		80-120	05-NOV-17
Lead (Pb)			92.5		%		80-120	05-NOV-17
Molybdenum (Mo)			91.4		%		80-120	05-NOV-17
Nickel (Ni)			97.8		%		80-120	05-NOV-17
Selenium (Se)			100.9		%		80-120	05-NOV-17
Silver (Ag)			94.9		%		80-120	05-NOV-17
Thallium (Tl)			92.1		%		80-120	05-NOV-17
Tin (Sn)			96.0		%		80-120	05-NOV-17
Uranium (U)			96.1		%		80-120	05-NOV-17
Vanadium (V)			100.0		%		80-120	05-NOV-17
Zinc (Zn)			97.5		%		80-120	05-NOV-17
WG2655767-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	05-NOV-17
Arsenic (As)			<0.10		mg/kg		0.1	05-NOV-17
Barium (Ba)			<0.50		mg/kg		0.5	05-NOV-17
Beryllium (Be)			<0.10		mg/kg		0.1	05-NOV-17
Cadmium (Cd)			<0.020		mg/kg		0.02	05-NOV-17
Chromium (Cr)			<0.50		mg/kg		0.5	05-NOV-17
Cobalt (Co)			<0.10		mg/kg		0.1	05-NOV-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R3875567								
WG2655767-1 MB								
Copper (Cu)			<0.50		mg/kg		0.5	05-NOV-17
Lead (Pb)			<0.50		mg/kg		0.5	05-NOV-17
Molybdenum (Mo)			<0.10		mg/kg		0.1	05-NOV-17
Nickel (Ni)			<0.50		mg/kg		0.5	05-NOV-17
Selenium (Se)			<0.20		mg/kg		0.2	05-NOV-17
Silver (Ag)			<0.10		mg/kg		0.1	05-NOV-17
Thallium (Tl)			<0.050		mg/kg		0.05	05-NOV-17
Tin (Sn)			<2.0		mg/kg		2	05-NOV-17
Uranium (U)			<0.050		mg/kg		0.05	05-NOV-17
Vanadium (V)			<0.20		mg/kg		0.2	05-NOV-17
Zinc (Zn)			<2.0		mg/kg		2	05-NOV-17
Batch R3877568								
WG2655767-4 CRM		**VA-CANMET-TILL1**						
Antimony (Sb)			112.7		%		70-130	06-NOV-17
Arsenic (As)			103.9		%		70-130	06-NOV-17
Barium (Ba)			101.4		%		70-130	06-NOV-17
Beryllium (Be)			0.56		mg/kg		0.34-0.74	06-NOV-17
Cadmium (Cd)			101.2		%		70-130	06-NOV-17
Chromium (Cr)			104.8		%		70-130	06-NOV-17
Cobalt (Co)			103.9		%		70-130	06-NOV-17
Copper (Cu)			102.5		%		70-130	06-NOV-17
Lead (Pb)			107.2		%		70-130	06-NOV-17
Molybdenum (Mo)			103.4		%		70-130	06-NOV-17
Nickel (Ni)			100.9		%		70-130	06-NOV-17
Selenium (Se)			0.30		mg/kg		0.11-0.51	06-NOV-17
Silver (Ag)			0.25		mg/kg		0.13-0.33	06-NOV-17
Thallium (Tl)			0.143		mg/kg		0.077-0.18	06-NOV-17
Tin (Sn)			1.1		mg/kg		0-3	06-NOV-17
Uranium (U)			108.5		%		70-130	06-NOV-17
Vanadium (V)			104.9		%		70-130	06-NOV-17
Zinc (Zn)			104.2		%		70-130	06-NOV-17
MOISTURE-VA	**Soil**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-VA	**Soil**							
Batch R3869951								
WG2652567-2 LCS								
Moisture			100.0		%		90-110	30-OCT-17
WG2652567-6 LCS								
Moisture			100.4		%		90-110	30-OCT-17
WG2652567-1 MB								
Moisture			<0.25		%		0.25	30-OCT-17
WG2652567-5 MB								
Moisture			<0.25		%		0.25	30-OCT-17
Batch R3871481								
WG2653318-8 DUP		**L2015183-3**						
Moisture		24.1	23.3		%	3.6	20	31-OCT-17
WG2653318-11 LCS								
Moisture			99.9		%		90-110	31-OCT-17
WG2653318-7 LCS								
Moisture			100.0		%		90-110	31-OCT-17
WG2653318-10 MB								
Moisture			<0.25		%		0.25	31-OCT-17
WG2653318-6 MB								
Moisture			<0.25		%		0.25	31-OCT-17
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R3876148								
WG2655782-2 LCS								
Acenaphthene			92.7		%		60-130	06-NOV-17
Acenaphthylene			92.6		%		60-130	06-NOV-17
Anthracene			94.1		%		60-130	06-NOV-17
Benz(a)anthracene			104.1		%		60-130	06-NOV-17
Benzo(a)pyrene			105.1		%		60-130	06-NOV-17
Benzo(b&j)fluoranthene			113.3		%		60-130	06-NOV-17
Benzo(g,h,i)perylene			93.9		%		60-130	06-NOV-17
Benzo(k)fluoranthene			112.5		%		60-130	06-NOV-17
Chrysene			105.3		%		60-130	06-NOV-17
Dibenz(a,h)anthracene			99.6		%		60-130	06-NOV-17
Fluoranthene			104.9		%		60-130	06-NOV-17
Fluorene			92.2		%		60-130	06-NOV-17
Indeno(1,2,3-c,d)pyrene			102.0		%		60-130	06-NOV-17
2-Methylnaphthalene			93.8		%		60-130	06-NOV-17
Naphthalene			93.6		%		50-130	06-NOV-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R3876148								
WG2655782-2 LCS								
Phenanthrene			96.5		%		60-130	06-NOV-17
Pyrene			105.6		%		60-130	06-NOV-17
WG2655782-1 MB								
Acenaphthene			<0.0050		mg/kg		0.005	06-NOV-17
Acenaphthylene			<0.0050		mg/kg		0.005	06-NOV-17
Anthracene			<0.0040		mg/kg		0.004	06-NOV-17
Benz(a)anthracene			<0.010		mg/kg		0.01	06-NOV-17
Benzo(a)pyrene			<0.010		mg/kg		0.01	06-NOV-17
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	06-NOV-17
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	06-NOV-17
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	06-NOV-17
Chrysene			<0.010		mg/kg		0.01	06-NOV-17
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	06-NOV-17
Fluoranthene			<0.010		mg/kg		0.01	06-NOV-17
Fluorene			<0.010		mg/kg		0.01	06-NOV-17
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	06-NOV-17
1-Methylnaphthalene			<0.050		mg/kg		0.05	06-NOV-17
2-Methylnaphthalene			<0.010		mg/kg		0.01	06-NOV-17
Naphthalene			<0.010		mg/kg		0.01	06-NOV-17
Phenanthrene			<0.010		mg/kg		0.01	06-NOV-17
Pyrene			<0.010		mg/kg		0.01	06-NOV-17
Quinoline			<0.050		mg/kg		0.05	06-NOV-17
Surrogate: Naphthalene d8			93.0		%		50-130	06-NOV-17
Surrogate: Acenaphthene d10			87.9		%		60-130	06-NOV-17
Surrogate: Phenanthrene d10			94.0		%		60-130	06-NOV-17
Surrogate: Chrysene d12			108.5		%		60-130	06-NOV-17
PH-1:2-VA	**Soil**							
Batch R3872470								
WG2653362-5 IRM		**VA-ALP-SRS1507**						
pH (1:2 soil:water)			6.41		pH		6.2-6.8	02-NOV-17
Batch R3875958								
WG2655767-5 IRM		**VA-ALP-SRS1507**						
pH (1:2 soil:water)			6.49		pH		6.2-6.8	06-NOV-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
STEROLS-SOX-MS-VA	**Soil**							
Batch R3893768								
WG2660089-1 MB								
Coprostanol			<0.050		mg/kg		0.05	23-NOV-17
Cholestanol			<0.050		mg/kg		0.05	23-NOV-17
TCOLI-DRY-MTF-VA	**Soil**							
Batch R3872334								
WG2652193-1 DUP		**L2015183-4**						
Coliform Bacteria - Total		3	3		MPN/g	0.0	65	30-OCT-17
WG2652193-2 MB								
Coliform Bacteria - Total			<2		MPN/g		2	30-OCT-17

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Miscellaneous							
Sterols by GCMS							
	1	28-OCT-17 14:50	08-NOV-17 16:53	7	11	days	EHT
	2	28-OCT-17 14:50	08-NOV-17 16:53	7	11	days	EHT
	3	28-OCT-17 18:30	08-NOV-17 16:53	7	11	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2015183 were received on 30-OCT-17 11:35.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

CHAIN OF CUSTODY RECORD/ANALYSIS REQUEST

No. 07977 page 1 of 1

Golder Associates
200 – 2920 Virtual Way
Vancouver, British Columbia, Canada V5M 0C4
Telephone (604) 296-4200 Fax (604) 298-5253

Project Number: 1657231			Laboratory Name: ALS
Short Title: Skagway Harbour	Golder Contact: Tamra Reynolds		Address: Vancouver
Golder E-mail Address 1: EAdshead @golder.com	Golder E-mail Address 2: TReynolds @golder.com		Telephone/Fax: rush	Contact: Amber Springer

Office Name: Whitehorse

EQuIS Facility Code:
EQuIS upload: ☐

Turnaround Time: ☐ 24 hr ☐ 48 hr ☐ 72 hr ☑ Regular (5 Days) (Coliforms - 48 hr TAT)
Criteria: ☐ CSR ☑ CCME ☐ BC Water Quality ☐ Other

Note: Final Reports to be issued by e-mail

Quote No.:

Analyses Required

Sample Control Number (SCN)	Sample Location	Sa. #	Sample Depth (m)	Sample Matrix (over)	Date Sampled (D / M / Y)	Time Sampled (HH:MM)	Sample Type (over)	QAQC Code (over)	Related SCN (over)	Number of Containers	~~[illegible]~~	Coprostanol						Total & Fecal Coliforms *	Metals (CCME)	RUSH (Select TAT above)	Remarks (over)
7977 -01	SED17-32 T		0-6"	SE	28/10/17	14:50	~~Grab~~ Comp			1	✓							✓			
-02	SED17-32 M		6-18"	↓	↓	14:50	↓			2	✓							✓			
-03	SED17-33 T		0-6"			18:30				1	✓							✓			
-04	SED17-33 M		6-13"			18:30				1								✓	✓		
-05																					
-06																					
-07																					
-08																					
-09																					
-10																					
-11																					
-12																					

Analysis TBT Will contact Tamra Monday Am

L2015183-COFC

Sampler's Signature: [signature]	Relinquished by: Signature [signature]	Company Golder	Date Oct 29 2017	Time 11:00	Received by: Signature	Company
Comments:	Method of Shipment: Air	Waybill No.:	Received for Lab by:	Date	Time
	Shipped by: Air North	Shipment Condition: Seal Intact:	Temp (°C) 5	Cooler opened by: JL	Date OCT 30 2017	Time 11 35AM

WHITE: Golder Copy YELLOW: Lab Copy

ESED

CHAIN OF CUSTODY RECORD/ANALYSIS REQUEST

No. 07977 page 1 of 1

Golder Associates
200 – 2920 Virtual Way
Vancouver, British Columbia, Canada V5M 0C4
Telephone (604) 296-4200 Fax (604) 298-5253

Project Number: 1657231
Short Title: Skagway Harbour
Golder Contact: Tamra Reynolds
Golder E-mail Address 1: eadsnead @golder.com
Golder E-mail Address 2: TReynolds @golder.com
Laboratory Name: ALS
Address: Vancouver
Telephone/Fax:
Contact: Amber Springer

Office Name: Whitehorse
EQuIS Facility Code: ______
EQuIS upload: ☐

Turnaround Time: ☐ 24 hr ☐ 48 hr ☐ 72 hr ☐ Regular (5 Days)
Criteria: ☐ CSR ☐ CCME ☐ BC Water Quality ☐ Other

Note: Final Reports to be issued by e-mail
Quote No.:

Analyses Required: Analysis TBT, Tamra will contact Monday AM

Sample Control Number (SCN)	Sample Location	Sa. #	Sample Depth (m)	Sample Matrix (over)	Date Sampled (D / M / Y)	Time Sampled (HH:MM)	Sample Type (over)	QAQC Code (over)	Related SCN (over)	Number of Containers	RUSH (Select TAT above)	Remarks (over)
7977 - 01	SED17-32 T		0-6"	SE	28/10/17	14:50	~~GRAB~~ COMP			1		
↓ - 02	SED17-32 M		6-18"	↓	↓	14:50	↓			2		
- 03	SED17-33 T		0-6"			18:30				1		
- 04	SED17-33 M		6-13"			18:20				1		
- 05												
- 06												
- 07												
- 08												
- 09												
- 10												
- 11												
- 12												

L2015183-COFC

Sampler's Signature:	Relinquished by: Signature	Company: Golder	Date: Oct 29 2017	Time: 11:00	Received by: Signature	Company
Comments:	Method of Shipment: Air	Waybill No.:	Received for Lab by:		Date	Time
	Shipped by: Air North	Shipment Condition: Seal Intact:	Temp (°C): 5	Cooler opened by: JC	Date: OCT 30 2017	Time: 1135AM

WHITE: Golder Copy YELLOW: Lab Copy

ESED

Laboratory Data Review Checklist

Completed by: Erin Adshead

Title: Environmental Geoscientist   Date: July 13, 2018

CS Report Name: Ore Basin Drilling Investigation   Report Date: July 13, 2018

Consultant Firm: Golder Associates Ltd.

Laboratory Name: ALS Environmental   Laboratory Report Number: L2015183

ADEC File Number: 1526.38.004   ADEC Harzard ID:

1. Laboratory
   a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?
      ☐**Yes** ☐ No ☐NA (Please explain.)   Comments:

   b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?
      ☐Yes ☐ No ☐**NA** (Please explain.)   Comments:

      Samples were not transferred to another laboratory.

2. Chain of Custody (COC)
   a. COC information completed, signed, and dated (including released/received by)?
      ☐**Yes** ☐ No ☐NA (Please explain.)   Comments:

   b. Correct analyses requested?
      ☐**Yes** ☐ No ☐NA (Please explain.)   Comments:

      Sterols results added 24 November 2017

3. Laboratory Sample Receipt Documentation
   a. Sample/cooler temperature documented and within range at receipt (4° ± 2°C)?
      ☐Yes ☐ **No** ☐NA (Please explain.)   Comments:

b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

☒**Yes** ☐ No ☐NA (Please explain.) Comments:

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

☒**Yes** ☐ No ☐NA (Please explain.) Comments:

Samples arrived in good condition and properly documented by the laboratory.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

☐**Yes** ☐ No ☒NA (Please explain.) Comments:

No discrepancies were identified.

e. Data quality or usability affected? (Please explain.)

Comments:

Data quality unaffected.

4. <u>Case Narrative</u>

a. Present and understandable?

☐**Yes** ☒ No ☐NA (Please explain.) Comments:

Reference information included for data qualifiers, and Quality Control Report. This is considered sufficient for QAQC purposes.

b. Discrepancies, errors or QC failures identified by the lab?

☐**Yes** ☐ No ☒NA (Please explain.) Comments:

1) Laboratory RPD could not be calculated for one fecal coliform analysis due to the result being less than detection limit

c. Were all corrective actions documented?

☐**Yes** ☐ No ☒NA (Please explain.) Comments:

Corrective actions were not necessary

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Data is considered usable for the purposes of this report.

5. <u>Samples Results</u>
   a. Correct analyses performed/reported as requested on COC?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

   b. All applicable holding times met?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

   c. All soils reported on a dry weight basis?
      ☐Yes ☐ No ☐**NA** (Please explain.) Comments:

   d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

yes

   e. Data quality or usability affected?
      Comments:

Practical Quantitation Limit (PQL)/ Method Reporting Limit (MRL) sufficient for assessment.

6. <u>QC Samples</u>
   a. Method Blank
      i. One method blank reported per matrix, analysis and 20 samples?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

      ii. All method blank results less than PQL?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

      iii. If above PQL, what samples are affected?
      Comments:

All method blank results were non-detect (ND) by the laboratory.

      iv. Do the affected sample(s) have data flags and if so, are the data flags clearly defined?
      ☐Yes ☐ No ☐**NA** (Please explain.) Comments:

No samples affected.

v. Data quality or usability affected? (Please explain.)

Comments:

Data quality not affected.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

☐**Yes** ☐ No ☐NA (Please explain.) Comments:

LCS/LCSD reported as per AK methods for organics, all results met acceptable criteria.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

☐Yes ☐ No ☐**NA** (Please explain.) Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

☐**Yes** ☐ No ☐NA (Please explain.) Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/MSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

☐**Yes** ☐ No ☐NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

☐Yes ☐ No ☐**NA** (Please explain.) Comments:

No samples effected.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality not affected.

c. Surrogates – Organics Only

i. Are surrogate recoveries reported for organic analyses – field, QC and laboratory samples?
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?
☐Yes ☐ No ☐**NA** (Please explain.) Comments:

Surrogate recoveries met acceptable criteria by laboratory.

iv. Data quality or usability affected? (Use the comment box to explain.)
Comments:

Data quality not affected.

d. Trip blank – Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

No trip blank collected

iii. All results less than PQL?
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?

Comments:

v. Data quality or usability affected? (Please explain.)

Comments:

Volatiles not analyzed therefore not considered to have a significant effect on the quality of results.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

☐**Yes** ☐ No ☐NA (Please explain.) Comments:

ii. Submitted blind to lab?

☐ **Yes** ☐ No ☐NA (Please explain.) Comments:

iii. Precision – All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

RPD (%) = Absolute value of: $\dfrac{(R_1-R_2)}{((R_1+R_2)/2)} \times 100$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

☐Yes ☐ **No** ☐NA (Please explain.) Comments:

Duplicate pairs reported several analytes outside Golder DQOs, RPDs above 20%: This is indicative of sample matrix heterogeneity and reflective of the composite sample collection method.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

These results will affect the interpretation of the data set.

f. Decontamination or Equipment Blank (If not used explain why).

☐**Yes** ☐ No ☐NA (Please explain.) Comments:

Given the nature of the sampling program (composite samples from split spoons) and equipment blank was not collected. Drill spoons were decontaminated prior to sample collection.

i. All results less than PQL?

☐**Yes** ☐ No ☐NA (Please explain.) Comments:

ii. If above PQL, what samples are affected?

Comments:

iii. Data quality or usability affected? (Please explain.)

Comments:

7. <u>Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)</u>
   a. Defined and appropriate?

☐**Yes** ☐ No ☐NA (Please explain.) Comments:

GOLDER ASSOCIATES LTD.
ATTN: Tamra Reynolds
203, 170 Titanium Way
Whitehorse YT Y1A 0G1

Date Received: 01-NOV-17
Report Date: 24-NOV-17 13:43 (MT)
Version: FINAL

Client Phone: 867-633-6076

Certificate of Analysis

Lab Work Order #: L2016641

Project P.O. #: NOT SUBMITTED
Job Reference: 1657231
C of C Numbers: 07978, 07979, 07980
Legal Site Desc:

Comments:

24-NOV-2017 Sterols data is included.

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2016641-1	L2016641-2	L2016641-3	L2016641-4	L2016641-5
	Sample ID	L2016641-1	L2016641-2	L2016641-3	L2016641-4	L2016641-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	30-OCT-17	30-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17
	Sampled Time			09:20	09:20	09:20
	Client ID	07978-03	07978-04	07978-05	07978-06	07978-07
SOIL						
Physical Tests	Moisture (%)	14.7	25.2		23.4	17.1
	pH (1:2 soil:water) (pH)	8.02	8.25	8.15	8.10	8.28
Bacteriological Tests	Coliform Bacteria - Fecal (MPN/g)		<2		<2	<2
	Coliform Bacteria - Total (MPN/g)		7		<2	3
Metals	Antimony (Sb) (mg/kg)	0.14	15.7	3.08	2.45	0.22
	Arsenic (As) (mg/kg)	0.57	18.8	3.36	4.35	1.69
	Barium (Ba) (mg/kg)	106	355	169	274	202
	Beryllium (Be) (mg/kg)	<0.10	0.36	0.14	0.24	0.19
	Cadmium (Cd) (mg/kg)	0.149	30.1	7.31	5.83	0.416
	Chromium (Cr) (mg/kg)	4.68	21.5	7.84	12.4	9.69
	Cobalt (Co) (mg/kg)	2.75	10.6	4.07	6.15	4.58
	Copper (Cu) (mg/kg)	5.36	436	75.0	90.1	16.2
	Lead (Pb) (mg/kg)	82.4	14100	3030	2200	195
	Mercury (Hg) (mg/kg)	0.0486	12.7	2.47	2.18	0.206
	Molybdenum (Mo) (mg/kg)	0.34	3.29	1.10	1.86	0.96
	Nickel (Ni) (mg/kg)	2.32	10.8	3.73	6.07	4.60
	Selenium (Se) (mg/kg)	<0.20	0.91	<0.20	0.22	<0.20
	Silver (Ag) (mg/kg)	0.13	15.2	3.32	2.31	0.25
	Thallium (Tl) (mg/kg)	0.097	2.48	0.568	0.531	0.196
	Tin (Sn) (mg/kg)	<2.0	4.2	<2.0	<2.0	<2.0
	Uranium (U) (mg/kg)	0.871	2.62	1.53	2.07	2.20
	Vanadium (V) (mg/kg)	20.2	67.4	27.8	42.8	34.2
	Zinc (Zn) (mg/kg)	120	19400	4610	3730	251
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)		0.0080		<0.0050	<0.0050
	Acenaphthylene (mg/kg)		0.0397		0.0108	0.0165
	Anthracene (mg/kg)		0.258		0.0261	0.0810
	Benz(a)anthracene (mg/kg)		2.21		0.106	0.257
	Benzo(a)pyrene (mg/kg)		1.20		0.102	0.165
	Benzo(b&j)fluoranthene (mg/kg)		3.12		0.260	0.343
	Benzo(b+j+k)fluoranthene (mg/kg)		4.02		0.353	0.475
	Benzo(g,h,i)perylene (mg/kg)		0.266		0.027	0.049
	Benzo(k)fluoranthene (mg/kg)		0.893		0.093	0.132
	Chrysene (mg/kg)		<2.0 DLCI		<0.20 DLCI	0.273
	Dibenz(a,h)anthracene (mg/kg)		0.146		0.0122	0.0188
	Fluoranthene (mg/kg)		1.03		0.131	0.432
	Fluorene (mg/kg)		0.175		<0.010	0.011

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2016641-6	L2016641-7	L2016641-8	L2016641-9	L2016641-10
	Description	SE	SE	SE	SE	SE
	Sampled Date	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17
	Sampled Time	09:20	10:30	10:30	12:15	12:15
	Client ID	07978-08	07978-09	07978-10	07978-11	07978-12
SOIL						
Physical Tests	Moisture (%)		15.5			20.0
	pH (1:2 soil:water) (pH)	8.08	8.41	8.25	8.45	8.33
Bacteriological Tests	Coliform Bacteria - Fecal (MPN/g)		<2			<2
	Coliform Bacteria - Total (MPN/g)		<2			<2
Metals	Antimony (Sb) (mg/kg)	1.05	<0.10	0.25	<0.10	0.24
	Arsenic (As) (mg/kg)	2.69	0.41	1.16	0.40	2.33
	Barium (Ba) (mg/kg)	230	107	138	95.4	208
	Beryllium (Be) (mg/kg)	0.21	<0.10	0.13	<0.10	0.18
	Cadmium (Cd) (mg/kg)	2.09	<0.050	0.217	<0.050	0.791
	Chromium (Cr) (mg/kg)	11.3	4.95	6.52	5.00	10.4
	Cobalt (Co) (mg/kg)	5.61	2.76	3.40	2.56	5.24
	Copper (Cu) (mg/kg)	36.9	2.54	14.0	5.19	33.9
	Lead (Pb) (mg/kg)	866	6.88	338	7.18	223
	Mercury (Hg) (mg/kg)	0.712	<0.0050	0.210	0.0100	0.404
	Molybdenum (Mo) (mg/kg)	1.79	0.17	0.71	0.24	0.98
	Nickel (Ni) (mg/kg)	5.49	2.72	2.82	2.38	5.26
	Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Silver (Ag) (mg/kg)	1.02	<0.10	0.34	<0.10	0.34
	Thallium (Tl) (mg/kg)	0.345	0.078	0.126	0.069	0.188
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Uranium (U) (mg/kg)	1.55	0.512	1.08	0.910	1.29
	Vanadium (V) (mg/kg)	40.3	19.0	26.0	17.7	37.9
	Zinc (Zn) (mg/kg)	1310	28.5	191	35.4	534
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)		<0.0050			
	Acenaphthylene (mg/kg)		<0.0050			
	Anthracene (mg/kg)		<0.0040			
	Benz(a)anthracene (mg/kg)		<0.010			
	Benzo(a)pyrene (mg/kg)		<0.010			
	Benzo(b&j)fluoranthene (mg/kg)		<0.010			
	Benzo(b+j+k)fluoranthene (mg/kg)		<0.015			
	Benzo(g,h,i)perylene (mg/kg)		<0.010			
	Benzo(k)fluoranthene (mg/kg)		<0.010			
	Chrysene (mg/kg)		<0.010			
	Dibenz(a,h)anthracene (mg/kg)		<0.0050			
	Fluoranthene (mg/kg)		<0.010			
	Fluorene (mg/kg)		<0.010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2016641-11	L2016641-12	L2016641-13	L2016641-14	L2016641-15
	Description	SE	SE	SE	SE	SE
	Sampled Date	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17
	Sampled Time	12:15	13:30	13:30	13:30	13:30
	Client ID	07979-01	07979-02	07979-03	07979-04	07979-05
SOIL						
Physical Tests	Moisture (%)	17.6	25.8		33.4	26.3
	pH (1:2 soil:water) (pH)	8.42	8.51	8.75	8.53	8.60
Bacteriological Tests	Coliform Bacteria - Fecal (MPN/g)	<2				
	Coliform Bacteria - Total (MPN/g)	<2				
Metals	Antimony (Sb) (mg/kg)	0.10	5.08	0.13	2.65	4.42
	Arsenic (As) (mg/kg)	1.11	7.79	0.65	8.39	6.64
	Barium (Ba) (mg/kg)	134	329	109	389	282
	Beryllium (Be) (mg/kg)	0.13	0.29	0.11	0.34	0.24
	Cadmium (Cd) (mg/kg)	0.171	12.8	0.358	7.24	9.82
	Chromium (Cr) (mg/kg)	6.53	16.9	4.64	22.6	14.6
	Cobalt (Co) (mg/kg)	3.19	7.86	2.73	8.88	6.79
	Copper (Cu) (mg/kg)	17.7	162	6.33	339	123
	Lead (Pb) (mg/kg)	80.1	4570	115	2500	3280
	Mercury (Hg) (mg/kg)	0.106	5.67	0.139	3.19	4.39
	Molybdenum (Mo) (mg/kg)	0.45	2.40	0.40	2.17	1.72
	Nickel (Ni) (mg/kg)	3.30	8.39	2.26	10.6	7.45
	Selenium (Se) (mg/kg)	<0.20	0.33	<0.20	0.34	0.24
	Silver (Ag) (mg/kg)	0.11	5.21	0.15	3.28	3.99
	Thallium (Tl) (mg/kg)	0.106	0.956	0.103	0.614	0.726
	Tin (Sn) (mg/kg)	<2.0	3.6	<2.0	25.9	6.9
	Uranium (U) (mg/kg)	1.51	1.86	1.58	2.04	1.76
	Vanadium (V) (mg/kg)	23.4	52.0	19.2	63.9	45.0
	Zinc (Zn) (mg/kg)	139	8240	242	4590	6180
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	0.142		0.0503	0.149
	Acenaphthylene (mg/kg)	0.0077	0.0888		0.129	0.0686
	Anthracene (mg/kg)	0.0171	1.58		0.428	0.728
	Benz(a)anthracene (mg/kg)	0.045	8.09		2.90	4.48
	Benzo(a)pyrene (mg/kg)	0.038	2.85		1.25	1.89
	Benzo(b&j)fluoranthene (mg/kg)	0.091	8.79		3.75	5.67
	Benzo(b+j+k)fluoranthene (mg/kg)	0.128	11.9		5.02	7.34
	Benzo(g,h,i)perylene (mg/kg)	0.011	0.554		0.278	0.402
	Benzo(k)fluoranthene (mg/kg)	0.037	3.08		1.27	1.67
	Chrysene (mg/kg)	0.061	6.94		DLCI <2.0	DLCI <3.0
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	0.370		0.143	0.223
	Fluoranthene (mg/kg)	0.055	15.8		5.21	10.1
	Fluorene (mg/kg)	<0.010	0.623		0.178	0.448

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2016641-16	L2016641-17	L2016641-18	L2016641-19	L2016641-20
	Description	SE	SE	SE	SE	SE
	Sampled Date	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17
	Sampled Time	14:30	14:30	14:30	15:40	15:40
	Client ID	07979-06	07979-07	07979-08	07979-09	07979-10
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	15.4	35.6		38.4	24.6
	pH (1:2 soil:water) (pH)	8.42	8.42	8.18	8.36	8.49
Bacteriological Tests	Coliform Bacteria - Fecal (MPN/g)	<2 PEHT	<2		<2	
	Coliform Bacteria - Total (MPN/g)	<2 PEHT	<2		4	
Metals	Antimony (Sb) (mg/kg)	14.9	23.4	0.54	1.02	0.60
	Arsenic (As) (mg/kg)	10.7	22.8	0.81	5.44	3.02
	Barium (Ba) (mg/kg)	211	341	121	437	244
	Beryllium (Be) (mg/kg)	0.16	0.37	<0.10	0.41	0.21
	Cadmium (Cd) (mg/kg)	16.2	34.3	0.638	2.39	1.52
	Chromium (Cr) (mg/kg)	8.09	21.5	5.68	21.8	12.0
	Cobalt (Co) (mg/kg)	4.93	10.7	2.97	10.1	5.89
	Copper (Cu) (mg/kg)	185	465	10.2	55.1	28.0
	Lead (Pb) (mg/kg)	14700	19500	493	840	547
	Mercury (Hg) (mg/kg)	6.56	13.7	0.268	0.959	0.553
	Molybdenum (Mo) (mg/kg)	1.31	4.44	0.35	2.27	1.76
	Nickel (Ni) (mg/kg)	3.97	11.6	2.48	11.7	6.07
	Selenium (Se) (mg/kg)	0.55	0.98	<0.20	0.28	<0.20
	Silver (Ag) (mg/kg)	14.1	21.9	0.51	1.42	0.81
	Thallium (Tl) (mg/kg)	2.44	3.96	0.182	0.473	0.269
	Tin (Sn) (mg/kg)	2.5	6.7	<2.0	2.1	<2.0
	Uranium (U) (mg/kg)	1.24	2.53	0.672	2.71	1.40
	Vanadium (V) (mg/kg)	29.7	68.6	21.1	71.8	39.3
	Zinc (Zn) (mg/kg)	10300	21600	458	1390	893
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)				<0.030 DLCI	0.0080
	Acenaphthylene (mg/kg)				0.0894	0.0320
	Anthracene (mg/kg)				0.304	0.236
	Benz(a)anthracene (mg/kg)				1.36	1.14
	Benzo(a)pyrene (mg/kg)				0.638	0.575
	Benzo(b&j)fluoranthene (mg/kg)				1.70	1.52
	Benzo(b+j+k)fluoranthene (mg/kg)				2.40	2.03
	Benzo(g,h,i)perylene (mg/kg)				0.156	0.144
	Benzo(k)fluoranthene (mg/kg)				0.707	0.508
	Chrysene (mg/kg)				1.27	1.23
	Dibenz(a,h)anthracene (mg/kg)				0.0703	0.0605
	Fluoranthene (mg/kg)				2.01	1.36
	Fluorene (mg/kg)				0.074	0.094

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2016641-21	L2016641-22	L2016641-23	L2016641-24	
	Sample ID	L2016641-21	L2016641-22	L2016641-23	L2016641-24	
	Description	SE	SE	SE	SE	
	Sampled Date	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17	
	Sampled Time	15:40	17:00	15:40	15:40	
	Client ID	07979-11	07979-12	07980-01	07980-02	
SOIL						
Physical Tests	Moisture (%)		19.2	29.7		
	pH (1:2 soil:water) (pH)	8.64	8.46	8.29	8.70	
Bacteriological Tests	Coliform Bacteria - Fecal (MPN/g)					
	Coliform Bacteria - Total (MPN/g)					
Metals	Antimony (Sb) (mg/kg)	<0.10	16.3	50.4	0.22	
	Arsenic (As) (mg/kg)	0.52	12.8	41.2	0.53	
	Barium (Ba) (mg/kg)	126	171	119	73.4	
	Beryllium (Be) (mg/kg)	0.10	0.15	0.28	0.11	
	Cadmium (Cd) (mg/kg)	0.096	50.6	105	0.382	
	Chromium (Cr) (mg/kg)	6.24	7.83	16.3	7.18	
	Cobalt (Co) (mg/kg)	3.09	5.48	12.2	3.22	
	Copper (Cu) (mg/kg)	5.33	472	1400	7.77	
	Lead (Pb) (mg/kg)	34.7	14400	41900	188	
	Mercury (Hg) (mg/kg)	0.0254	20.9	38.7	0.122	
	Molybdenum (Mo) (mg/kg)	0.48	1.71	6.30	0.22	
	Nickel (Ni) (mg/kg)	2.59	3.91	9.72	4.09	
	Selenium (Se) (mg/kg)	<0.20	0.74	3.02	<0.20	
	Silver (Ag) (mg/kg)	<0.10	15.3	>43.6	0.22	
	Thallium (Tl) (mg/kg)	0.091	2.36	7.44	0.098	
	Tin (Sn) (mg/kg)	<2.0	3.0	9.1	<2.0	
	Uranium (U) (mg/kg)	0.575	0.989	1.92	0.515	
	Vanadium (V) (mg/kg)	23.2	26.4	51.2	20.6	
	Zinc (Zn) (mg/kg)	79.4	33400	73800	261	
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)		0.0228	0.0861		
	Acenaphthylene (mg/kg)		0.0291	0.0596		
	Anthracene (mg/kg)		0.373	0.466		
	Benz(a)anthracene (mg/kg)		2.37	2.28		
	Benzo(a)pyrene (mg/kg)		1.09	1.54		
	Benzo(b&j)fluoranthene (mg/kg)		2.67	4.03		
	Benzo(b+j+k)fluoranthene (mg/kg)		3.63	5.36		
	Benzo(g,h,i)perylene (mg/kg)		0.302	0.484		
	Benzo(k)fluoranthene (mg/kg)		0.958	1.32		
	Chrysene (mg/kg)		1.78	2.34		
	Dibenz(a,h)anthracene (mg/kg)		0.130	0.193		
	Fluoranthene (mg/kg)		3.13	4.20		
	Fluorene (mg/kg)		0.146	0.223		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2016641-1	L2016641-2	L2016641-3	L2016641-4	L2016641-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	30-OCT-17	30-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17
	Sampled Time			09:20	09:20	09:20
	Client ID	07978-03	07978-04	07978-05	07978-06	07978-07
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Indeno(1,2,3-c,d)pyrene (mg/kg)		0.356		0.035	0.062
	1-Methylnaphthalene (mg/kg)		<0.050		<0.050	<0.050
	2-Methylnaphthalene (mg/kg)		<0.010		<0.010	<0.010
	Naphthalene (mg/kg)		<0.010		<0.010	<0.010
	Phenanthrene (mg/kg)		0.626		0.051	0.084
	Pyrene (mg/kg)		4.00		0.402	0.606
	Quinoline (mg/kg)		<0.050		<0.050	<0.050
	Surrogate: Acenaphthene d10 (%)		80.5		80.3	88.3
	Surrogate: Chrysene d12 (%)		95.8		103.1	109.6
	Surrogate: Naphthalene d8 (%)		79.3		83.7	92.8
	Surrogate: Phenanthrene d10 (%)		98.4		97.7	103.3
	B(a)P Total Potency Equivalent (mg/kg)		2.01		0.165	0.266
	IACR (CCME) (mg/kg)		36.3		2.92	4.43
Miscellaneous	Cholestanol (mg/kg)		0.074		0.066	<0.050
	Coprostanol (mg/kg)		<0.050		<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2016641-6	L2016641-7	L2016641-8	L2016641-9	L2016641-10
	Description	SE	SE	SE	SE	SE
	Sampled Date	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17
	Sampled Time	09:20	10:30	10:30	12:15	12:15
	Client ID	07978-08	07978-09	07978-10	07978-11	07978-12
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Indeno(1,2,3-c,d)pyrene (mg/kg)		<0.010			
	1-Methylnaphthalene (mg/kg)		<0.050			
	2-Methylnaphthalene (mg/kg)		<0.010			
	Naphthalene (mg/kg)		<0.010			
	Phenanthrene (mg/kg)		<0.010			
	Pyrene (mg/kg)		<0.010			
	Quinoline (mg/kg)		<0.050			
	Surrogate: Acenaphthene d10 (%)		81.3			
	Surrogate: Chrysene d12 (%)		102.6			
	Surrogate: Naphthalene d8 (%)		86.9			
	Surrogate: Phenanthrene d10 (%)		85.1			
	B(a)P Total Potency Equivalent (mg/kg)		<0.020			
	IACR (CCME) (mg/kg)		<0.15			
Miscellaneous	Cholestanol (mg/kg)		<0.050			<0.15
	Coprostanol (mg/kg)		<0.050			<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2016641-11	L2016641-12	L2016641-13	L2016641-14	L2016641-15
	Description	SE	SE	SE	SE	SE
	Sampled Date	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17
	Sampled Time	12:15	13:30	13:30	13:30	13:30
	Client ID	07979-01	07979-02	07979-03	07979-04	07979-05
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Indeno(1,2,3-c,d)pyrene (mg/kg)	0.014	0.706		0.368	0.490
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050		<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.010	0.020		0.017	0.017
	Naphthalene (mg/kg)	<0.010	0.015		0.013	0.019
	Phenanthrene (mg/kg)	0.031	2.02		0.720	1.20
	Pyrene (mg/kg)	0.091	11.6		7.89	8.32
	Quinoline (mg/kg)	<0.050	<0.050		<0.050	<0.050
	Surrogate: Acenaphthene d10 (%)	81.1	85.0		84.6	89.1
	Surrogate: Chrysene d12 (%)	99.4	89.9		92.6	98.3
	Surrogate: Naphthalene d8 (%)	85.8	78.0		79.6	83.7
	Surrogate: Phenanthrene d10 (%)	93.2	96.8		99.4	104.0
	B(a)P Total Potency Equivalent (mg/kg)	0.060	5.36		2.24	3.36
	IACR (CCME) (mg/kg)	1.08	112		44.8	66.5
Miscellaneous	Cholestanol (mg/kg)	<0.050				
	Coprostanol (mg/kg)	<0.050				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2016641-16	L2016641-17	L2016641-18	L2016641-19	L2016641-20
	Description	SE	SE	SE	SE	SE
	Sampled Date	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17
	Sampled Time	14:30	14:30	14:30	15:40	15:40
	Client ID	07979-06	07979-07	07979-08	07979-09	07979-10
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Indeno(1,2,3-c,d)pyrene (mg/kg)				0.201	0.196
	1-Methylnaphthalene (mg/kg)				<0.050	<0.050
	2-Methylnaphthalene (mg/kg)				<0.010	<0.010
	Naphthalene (mg/kg)				0.012	<0.010
	Phenanthrene (mg/kg)				0.481	0.303
	Pyrene (mg/kg)				4.73	3.14
	Quinoline (mg/kg)				<0.050	<0.050
	Surrogate: Acenaphthene d10 (%)				93.4	87.6
	Surrogate: Chrysene d12 (%)				102.2	99.7
	Surrogate: Naphthalene d8 (%)				93.9	88.6
	Surrogate: Phenanthrene d10 (%)				108.0	100.8
	B(a)P Total Potency Equivalent (mg/kg)				1.12	0.985
	IACR (CCME) (mg/kg)				21.9	18.6
Miscellaneous	Cholestanol (mg/kg)	<0.050	<0.050		<0.050	
	Coprostanol (mg/kg)	<0.050	<0.050		<0.050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2016641-21	L2016641-22	L2016641-23	L2016641-24	
	Description	SE	SE	SE	SE	
	Sampled Date	31-OCT-17	31-OCT-17	31-OCT-17	31-OCT-17	
	Sampled Time	15:40	17:00	15:40	15:40	
	Client ID	07979-11	07979-12	07980-01	07980-02	
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Indeno(1,2,3-c,d)pyrene (mg/kg)		0.407	0.631		
	1-Methylnaphthalene (mg/kg)		<0.050	<0.050		
	2-Methylnaphthalene (mg/kg)		<0.010	0.012		
	Naphthalene (mg/kg)		<0.010	0.011		
	Phenanthrene (mg/kg)		1.36	2.19		
	Pyrene (mg/kg)		4.35	7.24		
	Quinoline (mg/kg)		<0.050	<0.050		
	Surrogate: Acenaphthene d10 (%)		81.0	78.9		
	Surrogate: Chrysene d12 (%)		92.1	88.4		
	Surrogate: Naphthalene d8 (%)		82.4	79.3		
	Surrogate: Phenanthrene d10 (%)		96.5	93.5		
	B(a)P Total Potency Equivalent (mg/kg)		1.88	2.59		
	IACR (CCME) (mg/kg)		34.4	46.8		
Miscellaneous	Cholestanol (mg/kg)					
	Coprostanol (mg/kg)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Mercury (Hg)	DUP-H	L2016641-1, -10, -13, -16, -17, -18, -21, -24, -3, -6, -8, -9
Duplicate	Antimony (Sb)	DUP-H	L2016641-10
Duplicate	Arsenic (As)	DUP-H	L2016641-10
Duplicate	Lead (Pb)	DUP-H	L2016641-11, -12, -14, -15, -19, -2, -20, -22, -23, -4, -5, -7
Duplicate	Molybdenum (Mo)	DUP-H	L2016641-11, -12, -14, -15, -19, -2, -20, -22, -23, -4, -5, -7
Duplicate	Tin (Sn)	DUP-H	L2016641-10
Duplicate	Uranium (U)	DUP-H	L2016641-11, -12, -14, -15, -19, -2, -20, -22, -23, -4, -5, -7
Duplicate	Benz(a)anthracene	DUP-H	L2016641-11, -12, -14, -15, -19, -2, -20, -22, -23, -4, -5, -7
Duplicate	Dibenz(a,h)anthracene	DUP-H	L2016641-11, -12, -14, -15, -19, -2, -20, -22, -23, -4, -5, -7
Duplicate	Fluoranthene	DUP-H	L2016641-11, -12, -14, -15, -19, -2, -20, -22, -23, -4, -5, -7
Duplicate	Fluorene	DUP-H	L2016641-11, -12, -14, -15, -19, -2, -20, -22, -23, -4, -5, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLCI	Detection Limit Raised: Chromatographic Interference due to co-elution.
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
PEHT	Parameter Exceeded Recommended Holding Time Prior to Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
FCOLI-DRY-MTF-VA	Soil	Fecal coliform by MPN	EPA Method 1680

This analysis is carried out using procedures adapted from EPA Method 1680 "Fecal Coliforms in Sewage Sludge (Biosolids) by Multiple Tube Fermentation using Lauryl Tryptose Broth (LTB) and EC medium". Serial dilutions of the sample are incubated with the appropriate growth medium, and fecal coliforms are quantified by a statistical estimation of bacteria density (most probable number). The test involves initial 48 hour incubation (presumptive test), positive results are further tested (up to an additional 24 hours) to confirm and quantify fecal coliforms.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

This method uses a heated strong acid digestion with HNO3 and HCl and is intended to liberate metals that may be environmentally available. Silicate minerals are not solubilized. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. Analysis is by Collision/Reaction Cell ICPMS.

MOISTURE-VA	Soil	Moisture content	CWS for PHC in Soil - Tier 1

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

PAH-TMB-H/A-MS-VA	Soil	PAH - Rotary Extraction (Hexane/Acetone)	EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

STEROLS-SOX-MS-VA	Soil	Sterols by GCMS	EPA 3570 & 8270 / J. OF CHROM. 1108
TCOLI-DRY-MTF-VA	Soil	Total coliform by MPN	TMECC 07.00 PATHOGENS

This analysis is carried out using procedures adapted from TMECC 07.00 PATHOGENS. This method describes multiple-tube fermentation technique

Reference Information

for the detection and enumeration of total coliforms. Serial dilutions of the sample are incubated with the appropriate growth medium, and total coliforms are quantified by a statistical estimation of bacteria density (most probable number). The test involves initial 48 hour incubation (presumptive test); positive results do not require further testing for confirmation of total coliforms.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

07978	07979	07980

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2016641 Report Date: 24-NOV-17

Client: GOLDER ASSOCIATES LTD.
203, 170 Titanium Way
Whitehorse YT Y1A 0G1

Contact: Tamra Reynolds

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
FCOLI-DRY-MTF-VA	**Soil**							
Batch R3875474								
WG2654667-1 DUP		**L2016641-19**						
Coliform Bacteria - Fecal		<2	<2	RPD-NA	MPN/g	N/A	65	01-NOV-17
WG2654667-2 MB								
Coliform Bacteria - Fecal			<2		MPN/g		2	01-NOV-17
Batch R3878624								
WG2656594-2 MB								
Coliform Bacteria - Fecal			<2		MPN/g		2	03-NOV-17
HG-200.2-CVAF-VA	**Soil**							
Batch R3878063								
WG2656735-4 CRM		**VA-CANMET-TILL1**						
Mercury (Hg)			102.0		%		70-130	07-NOV-17
WG2656735-2 DUP		**L2016641-5**						
Mercury (Hg)		0.206	0.142		mg/kg	37	40	07-NOV-17
WG2656735-3 LCS								
Mercury (Hg)			104.9		%		70-130	07-NOV-17
WG2656735-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	07-NOV-17
Batch R3878462								
WG2656742-4 CRM		**VA-CANMET-TILL1**						
Mercury (Hg)			101.5		%		70-130	07-NOV-17
WG2656742-2 DUP		**L2016641-10**						
Mercury (Hg)		0.404	0.611	DUP-H	mg/kg	41	40	07-NOV-17
WG2656742-3 LCS								
Mercury (Hg)			99.7		%		70-130	07-NOV-17
WG2656742-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	07-NOV-17
MET-200.2-CCMS-VA	**Soil**							
Batch R3878766								
WG2656735-4 CRM		**VA-CANMET-TILL1**						
Antimony (Sb)			104.3		%		70-130	06-NOV-17
Arsenic (As)			97.3		%		70-130	06-NOV-17
Barium (Ba)			95.1		%		70-130	06-NOV-17
Beryllium (Be)			0.53		mg/kg		0.34-0.74	06-NOV-17
Cadmium (Cd)			98.9		%		70-130	06-NOV-17
Chromium (Cr)			98.8		%		70-130	06-NOV-17
Cobalt (Co)			97.9		%		70-130	06-NOV-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R3878766								
WG2656735-4 CRM		**VA-CANMET-TILL1**						
Copper (Cu)			97.5		%		70-130	06-NOV-17
Lead (Pb)			99.3		%		70-130	06-NOV-17
Molybdenum (Mo)			99.3		%		70-130	06-NOV-17
Nickel (Ni)			100.5		%		70-130	06-NOV-17
Selenium (Se)			0.33		mg/kg		0.11-0.51	06-NOV-17
Silver (Ag)			0.22		mg/kg		0.13-0.33	06-NOV-17
Thallium (Tl)			0.126		mg/kg		0.077-0.18	06-NOV-17
Tin (Sn)			1.0		mg/kg		0-3	06-NOV-17
Uranium (U)			102.1		%		70-130	06-NOV-17
Vanadium (V)			101.4		%		70-130	06-NOV-17
Zinc (Zn)			98.2		%		70-130	06-NOV-17
WG2656735-2 DUP		**L2016641-5**						
Antimony (Sb)		0.22	0.15	J	mg/kg	0.06	0.2	06-NOV-17
Arsenic (As)		1.69	1.47		mg/kg	14	30	06-NOV-17
Barium (Ba)		202	194		mg/kg	4.3	40	06-NOV-17
Beryllium (Be)		0.19	0.17		mg/kg	12	30	06-NOV-17
Cadmium (Cd)		0.416	0.365		mg/kg	13	30	06-NOV-17
Chromium (Cr)		9.69	9.50		mg/kg	1.9	30	06-NOV-17
Cobalt (Co)		4.58	4.45		mg/kg	2.9	30	06-NOV-17
Copper (Cu)		16.2	14.1		mg/kg	13	30	06-NOV-17
Lead (Pb)		195	127	DUP-H	mg/kg	43	40	06-NOV-17
Molybdenum (Mo)		0.96	0.62	DUP-H	mg/kg	44	40	06-NOV-17
Nickel (Ni)		4.60	4.75		mg/kg	3.2	30	06-NOV-17
Selenium (Se)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	06-NOV-17
Silver (Ag)		0.25	0.20		mg/kg	24	40	06-NOV-17
Thallium (Tl)		0.196	0.175		mg/kg	11	30	06-NOV-17
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	06-NOV-17
Uranium (U)		2.20	1.33	DUP-H	mg/kg	49	30	06-NOV-17
Vanadium (V)		34.2	32.5		mg/kg	5.2	30	06-NOV-17
Zinc (Zn)		251	225		mg/kg	11	30	06-NOV-17
WG2656735-3 LCS								
Antimony (Sb)			107.1		%		80-120	06-NOV-17
Arsenic (As)			99.9		%		80-120	06-NOV-17
Barium (Ba)			99.3		%		80-120	06-NOV-17
Beryllium (Be)			98.9		%		80-120	06-NOV-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R3878766								
WG2656735-3 LCS								
Cadmium (Cd)			100.8		%		80-120	06-NOV-17
Chromium (Cr)			98.2		%		80-120	06-NOV-17
Cobalt (Co)			96.6		%		80-120	06-NOV-17
Copper (Cu)			96.6		%		80-120	06-NOV-17
Lead (Pb)			98.7		%		80-120	06-NOV-17
Molybdenum (Mo)			96.6		%		80-120	06-NOV-17
Nickel (Ni)			97.7		%		80-120	06-NOV-17
Selenium (Se)			101.2		%		80-120	06-NOV-17
Silver (Ag)			97.5		%		80-120	06-NOV-17
Thallium (Tl)			96.3		%		80-120	06-NOV-17
Tin (Sn)			100.4		%		80-120	06-NOV-17
Uranium (U)			100.5		%		80-120	06-NOV-17
Vanadium (V)			100.7		%		80-120	06-NOV-17
Zinc (Zn)			92.1		%		80-120	06-NOV-17
WG2656735-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	06-NOV-17
Arsenic (As)			<0.10		mg/kg		0.1	06-NOV-17
Barium (Ba)			<0.50		mg/kg		0.5	06-NOV-17
Beryllium (Be)			<0.10		mg/kg		0.1	06-NOV-17
Cadmium (Cd)			<0.020		mg/kg		0.02	06-NOV-17
Chromium (Cr)			<0.50		mg/kg		0.5	06-NOV-17
Cobalt (Co)			<0.10		mg/kg		0.1	06-NOV-17
Copper (Cu)			<0.50		mg/kg		0.5	06-NOV-17
Lead (Pb)			<0.50		mg/kg		0.5	06-NOV-17
Molybdenum (Mo)			<0.10		mg/kg		0.1	06-NOV-17
Nickel (Ni)			<0.50		mg/kg		0.5	06-NOV-17
Selenium (Se)			<0.20		mg/kg		0.2	06-NOV-17
Silver (Ag)			<0.10		mg/kg		0.1	06-NOV-17
Thallium (Tl)			<0.050		mg/kg		0.05	06-NOV-17
Tin (Sn)			<2.0		mg/kg		2	06-NOV-17
Uranium (U)			<0.050		mg/kg		0.05	06-NOV-17
Vanadium (V)			<0.20		mg/kg		0.2	06-NOV-17
Zinc (Zn)			<2.0		mg/kg		2	06-NOV-17

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R3879144								
WG2656742-4 CRM		**VA-CANMET-TILL1**						
Antimony (Sb)			105.4		%		70-130	07-NOV-17
Arsenic (As)			101.0		%		70-130	07-NOV-17
Barium (Ba)			94.2		%		70-130	07-NOV-17
Beryllium (Be)			0.54		mg/kg		0.34-0.74	07-NOV-17
Cadmium (Cd)			103.8		%		70-130	07-NOV-17
Chromium (Cr)			100.1		%		70-130	07-NOV-17
Cobalt (Co)			100.0		%		70-130	07-NOV-17
Copper (Cu)			97.1		%		70-130	07-NOV-17
Lead (Pb)			98.8		%		70-130	07-NOV-17
Molybdenum (Mo)			93.5		%		70-130	07-NOV-17
Nickel (Ni)			99.6		%		70-130	07-NOV-17
Selenium (Se)			0.29		mg/kg		0.11-0.51	07-NOV-17
Silver (Ag)			0.24		mg/kg		0.13-0.33	07-NOV-17
Thallium (Tl)			0.124		mg/kg		0.077-0.18	07-NOV-17
Tin (Sn)			1.1		mg/kg		0-3	07-NOV-17
Uranium (U)			102.5		%		70-130	07-NOV-17
Vanadium (V)			101.7		%		70-130	07-NOV-17
Zinc (Zn)			99.4		%		70-130	07-NOV-17
WG2656742-3 LCS								
Antimony (Sb)			102.6		%		80-120	07-NOV-17
Arsenic (As)			101.8		%		80-120	07-NOV-17
Barium (Ba)			97.7		%		80-120	07-NOV-17
Beryllium (Be)			100.4		%		80-120	07-NOV-17
Cadmium (Cd)			99.8		%		80-120	07-NOV-17
Chromium (Cr)			96.7		%		80-120	07-NOV-17
Cobalt (Co)			97.9		%		80-120	07-NOV-17
Copper (Cu)			96.5		%		80-120	07-NOV-17
Lead (Pb)			97.7		%		80-120	07-NOV-17
Molybdenum (Mo)			98.2		%		80-120	07-NOV-17
Nickel (Ni)			97.2		%		80-120	07-NOV-17
Selenium (Se)			96.5		%		80-120	07-NOV-17
Silver (Ag)			100.5		%		80-120	07-NOV-17
Thallium (Tl)			96.8		%		80-120	07-NOV-17
Tin (Sn)			101.3		%		80-120	07-NOV-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R3879144								
WG2656742-3 LCS								
Uranium (U)			102.0		%		80-120	07-NOV-17
Vanadium (V)			100.5		%		80-120	07-NOV-17
Zinc (Zn)			95.8		%		80-120	07-NOV-17
WG2656742-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	07-NOV-17
Arsenic (As)			<0.10		mg/kg		0.1	07-NOV-17
Barium (Ba)			<0.50		mg/kg		0.5	07-NOV-17
Beryllium (Be)			<0.10		mg/kg		0.1	07-NOV-17
Cadmium (Cd)			<0.020		mg/kg		0.02	07-NOV-17
Chromium (Cr)			<0.50		mg/kg		0.5	07-NOV-17
Cobalt (Co)			<0.10		mg/kg		0.1	07-NOV-17
Copper (Cu)			<0.50		mg/kg		0.5	07-NOV-17
Lead (Pb)			<0.50		mg/kg		0.5	07-NOV-17
Molybdenum (Mo)			<0.10		mg/kg		0.1	07-NOV-17
Nickel (Ni)			<0.50		mg/kg		0.5	07-NOV-17
Selenium (Se)			<0.20		mg/kg		0.2	07-NOV-17
Silver (Ag)			<0.10		mg/kg		0.1	07-NOV-17
Thallium (Tl)			<0.050		mg/kg		0.05	07-NOV-17
Tin (Sn)			<2.0		mg/kg		2	07-NOV-17
Uranium (U)			<0.050		mg/kg		0.05	07-NOV-17
Vanadium (V)			<0.20		mg/kg		0.2	07-NOV-17
Zinc (Zn)			<2.0		mg/kg		2	07-NOV-17
Batch R3880111								
WG2660087-4 CRM		**VA-CANMET-TILL1**						
Antimony (Sb)			106.0		%		70-130	09-NOV-17
Arsenic (As)			106.2		%		70-130	09-NOV-17
Barium (Ba)			100.0		%		70-130	09-NOV-17
Beryllium (Be)			0.51		mg/kg		0.34-0.74	09-NOV-17
Cadmium (Cd)			106.2		%		70-130	09-NOV-17
Chromium (Cr)			102.9		%		70-130	09-NOV-17
Cobalt (Co)			105.9		%		70-130	09-NOV-17
Copper (Cu)			105.3		%		70-130	09-NOV-17
Lead (Pb)			100.4		%		70-130	09-NOV-17
Molybdenum (Mo)			93.6		%		70-130	09-NOV-17
Nickel (Ni)			106.1		%		70-130	09-NOV-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R3880111								
WG2660087-4 CRM		**VA-CANMET-TILL1**						
Selenium (Se)			0.30		mg/kg		0.11-0.51	09-NOV-17
Silver (Ag)			0.24		mg/kg		0.13-0.33	09-NOV-17
Thallium (Tl)			0.127		mg/kg		0.077-0.18	09-NOV-17
Tin (Sn)			1.1		mg/kg		0-3	09-NOV-17
Uranium (U)			103.7		%		70-130	09-NOV-17
Vanadium (V)			107.2		%		70-130	09-NOV-17
Zinc (Zn)			107.9		%		70-130	09-NOV-17
WG2660087-7 DUP		**L2016641-10**						
Antimony (Sb)		0.24	0.25		mg/kg	4.2	30	09-NOV-17
Arsenic (As)		2.33	2.31		mg/kg	1.2	30	09-NOV-17
Barium (Ba)		208	193		mg/kg	7.3	40	09-NOV-17
Beryllium (Be)		0.18	0.19		mg/kg	5.7	30	09-NOV-17
Cadmium (Cd)		0.791	0.945		mg/kg	18	30	09-NOV-17
Chromium (Cr)		10.4	10.2		mg/kg	2.1	30	09-NOV-17
Cobalt (Co)		5.24	5.13		mg/kg	2.2	30	09-NOV-17
Copper (Cu)		33.9	35.6		mg/kg	4.8	30	09-NOV-17
Lead (Pb)		223	216		mg/kg	2.9	40	09-NOV-17
Molybdenum (Mo)		0.98	1.06		mg/kg	7.1	40	09-NOV-17
Nickel (Ni)		5.26	5.19		mg/kg	1.4	30	09-NOV-17
Selenium (Se)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	09-NOV-17
Silver (Ag)		0.34	0.32		mg/kg	5.8	40	09-NOV-17
Thallium (Tl)		0.188	0.178		mg/kg	5.8	30	09-NOV-17
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	09-NOV-17
Uranium (U)		1.29	1.18		mg/kg	8.9	30	09-NOV-17
Vanadium (V)		37.9	36.7		mg/kg	3.2	30	09-NOV-17
Zinc (Zn)		534	639		mg/kg	18	30	09-NOV-17
WG2660087-3 LCS								
Antimony (Sb)			106.4		%		80-120	09-NOV-17
Arsenic (As)			108.1		%		80-120	09-NOV-17
Barium (Ba)			105.7		%		80-120	09-NOV-17
Beryllium (Be)			96.9		%		80-120	09-NOV-17
Cadmium (Cd)			104.4		%		80-120	09-NOV-17
Chromium (Cr)			98.0		%		80-120	09-NOV-17
Cobalt (Co)			103.4		%		80-120	09-NOV-17
Copper (Cu)			104.2		%		80-120	09-NOV-17

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R3880111								
WG2660087-3 LCS								
Lead (Pb)			99.2		%		80-120	09-NOV-17
Molybdenum (Mo)			94.2		%		80-120	09-NOV-17
Nickel (Ni)			103.6		%		80-120	09-NOV-17
Selenium (Se)			104.8		%		80-120	09-NOV-17
Silver (Ag)			99.9		%		80-120	09-NOV-17
Thallium (Tl)			97.7		%		80-120	09-NOV-17
Tin (Sn)			102.0		%		80-120	09-NOV-17
Uranium (U)			99.5		%		80-120	09-NOV-17
Vanadium (V)			107.7		%		80-120	09-NOV-17
Zinc (Zn)			99.2		%		80-120	09-NOV-17
WG2660087-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	09-NOV-17
Arsenic (As)			<0.10		mg/kg		0.1	09-NOV-17
Barium (Ba)			<0.50		mg/kg		0.5	09-NOV-17
Beryllium (Be)			<0.10		mg/kg		0.1	09-NOV-17
Cadmium (Cd)			<0.020		mg/kg		0.02	09-NOV-17
Chromium (Cr)			<0.50		mg/kg		0.5	09-NOV-17
Cobalt (Co)			<0.10		mg/kg		0.1	09-NOV-17
Copper (Cu)			<0.50		mg/kg		0.5	09-NOV-17
Lead (Pb)			<0.50		mg/kg		0.5	09-NOV-17
Molybdenum (Mo)			<0.10		mg/kg		0.1	09-NOV-17
Nickel (Ni)			<0.50		mg/kg		0.5	09-NOV-17
Selenium (Se)			<0.20		mg/kg		0.2	09-NOV-17
Silver (Ag)			<0.10		mg/kg		0.1	09-NOV-17
Thallium (Tl)			<0.050		mg/kg		0.05	09-NOV-17
Tin (Sn)			<2.0		mg/kg		2	09-NOV-17
Uranium (U)			<0.050		mg/kg		0.05	09-NOV-17
Vanadium (V)			<0.20		mg/kg		0.2	09-NOV-17
Zinc (Zn)			<2.0		mg/kg		2	09-NOV-17
MOISTURE-VA	**Soil**							
Batch R3878483								
WG2658106-3 DUP		**L2016641-23**						
Moisture		29.7	29.5		%	0.5	20	07-NOV-17
WG2658106-4 DUP		**L2016641-10**						
Moisture		20.0	19.5		%	2.6	20	07-NOV-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-VA	**Soil**							
Batch R3878483								
WG2658106-2 LCS								
Moisture			100.1		%		90-110	07-NOV-17
WG2658106-6 LCS								
Moisture			99.7		%		90-110	07-NOV-17
WG2658106-1 MB								
Moisture			<0.25		%		0.25	07-NOV-17
WG2658106-5 MB								
Moisture			<0.25		%		0.25	07-NOV-17
Batch R3878635								
WG2658724-2 LCS								
Moisture			99.9		%		90-110	07-NOV-17
WG2658724-6 LCS								
Moisture			99.9		%		90-110	07-NOV-17
WG2658724-1 MB								
Moisture			<0.25		%		0.25	07-NOV-17
WG2658724-5 MB								
Moisture			<0.25		%		0.25	07-NOV-17
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R3876148								
WG2656734-4 DUP		**L2016641-2**						
Acenaphthene		0.0080	0.0072		mg/kg	10	50	08-NOV-17
Acenaphthylene		0.0397	0.0283		mg/kg	34	50	08-NOV-17
Anthracene		0.258	0.195		mg/kg	28	50	08-NOV-17
Benz(a)anthracene		2.21	1.21	DUP-H	mg/kg	58	50	08-NOV-17
Benzo(a)pyrene		1.20	0.806		mg/kg	39	50	08-NOV-17
Benzo(b&j)fluoranthene		3.12	2.04		mg/kg	42	50	08-NOV-17
Benzo(g,h,i)perylene		0.266	0.165		mg/kg	47	50	08-NOV-17
Benzo(k)fluoranthene		0.893	0.658		mg/kg	30	50	08-NOV-17
Chrysene		<2.0	<1.5	RPD-NA	mg/kg	N/A	50	08-NOV-17
Dibenz(a,h)anthracene		0.146	0.0850	DUP-H	mg/kg	53	50	08-NOV-17
Fluoranthene		1.03	0.551	DUP-H	mg/kg	60	50	08-NOV-17
Fluorene		0.175	0.101	DUP-H	mg/kg	54	50	08-NOV-17
Indeno(1,2,3-c,d)pyrene		0.356	0.225		mg/kg	45	50	08-NOV-17
1-Methylnaphthalene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	08-NOV-17
2-Methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-NOV-17
Naphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-NOV-17
Phenanthrene		0.626	0.397		mg/kg	45	50	08-NOV-17

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R3876148								
WG2656734-4 DUP		**L2016641-2**						
Pyrene		4.00	3.15		mg/kg	24	50	08-NOV-17
Quinoline		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	08-NOV-17
WG2656734-2 LCS								
Acenaphthene			84.8		%		60-130	08-NOV-17
Acenaphthylene			84.6		%		60-130	08-NOV-17
Anthracene			82.6		%		60-130	08-NOV-17
Benz(a)anthracene			97.4		%		60-130	08-NOV-17
Benzo(a)pyrene			99.1		%		60-130	08-NOV-17
Benzo(b&j)fluoranthene			109.2		%		60-130	08-NOV-17
Benzo(g,h,i)perylene			83.9		%		60-130	08-NOV-17
Benzo(k)fluoranthene			106.3		%		60-130	08-NOV-17
Chrysene			94.3		%		60-130	08-NOV-17
Dibenz(a,h)anthracene			92.7		%		60-130	08-NOV-17
Fluoranthene			101.4		%		60-130	08-NOV-17
Fluorene			85.0		%		60-130	08-NOV-17
Indeno(1,2,3-c,d)pyrene			93.1		%		60-130	08-NOV-17
2-Methylnaphthalene			84.9		%		60-130	08-NOV-17
Naphthalene			86.5		%		50-130	08-NOV-17
Phenanthrene			92.8		%		60-130	08-NOV-17
Pyrene			102.2		%		60-130	08-NOV-17
WG2656734-1 MB								
Acenaphthene			<0.0050		mg/kg		0.005	08-NOV-17
Acenaphthylene			<0.0050		mg/kg		0.005	08-NOV-17
Anthracene			<0.0040		mg/kg		0.004	08-NOV-17
Benz(a)anthracene			<0.010		mg/kg		0.01	08-NOV-17
Benzo(a)pyrene			<0.010		mg/kg		0.01	08-NOV-17
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	08-NOV-17
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	08-NOV-17
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	08-NOV-17
Chrysene			<0.010		mg/kg		0.01	08-NOV-17
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	08-NOV-17
Fluoranthene			<0.010		mg/kg		0.01	08-NOV-17
Fluorene			<0.010		mg/kg		0.01	08-NOV-17
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	08-NOV-17
1-Methylnaphthalene			<0.050		mg/kg		0.05	08-NOV-17

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R3876148								
WG2656734-1 MB								
2-Methylnaphthalene			<0.010		mg/kg		0.01	08-NOV-17
Naphthalene			<0.010		mg/kg		0.01	08-NOV-17
Phenanthrene			<0.010		mg/kg		0.01	08-NOV-17
Pyrene			<0.010		mg/kg		0.01	08-NOV-17
Quinoline			<0.050		mg/kg		0.05	08-NOV-17
Surrogate: Naphthalene d8			88.8		%		50-130	08-NOV-17
Surrogate: Acenaphthene d10			83.0		%		60-130	08-NOV-17
Surrogate: Phenanthrene d10			88.8		%		60-130	08-NOV-17
Surrogate: Chrysene d12			104.0		%		60-130	08-NOV-17
PH-1:2-VA	**Soil**							
Batch R3876939								
WG2656735-2 DUP		**L2016641-5**						
pH (1:2 soil:water)		8.28	8.33	J	pH	0.05	0.2	07-NOV-17
WG2656735-5 IRM		**VA-ALP-SRS1507**						
pH (1:2 soil:water)			6.41		pH		6.2-6.8	07-NOV-17
Batch R3876941								
WG2656742-2 DUP		**L2016641-10**						
pH (1:2 soil:water)		8.33	8.41	J	pH	0.08	0.2	07-NOV-17
WG2656742-5 IRM		**VA-ALP-SRS1507**						
pH (1:2 soil:water)			6.49		pH		6.2-6.8	07-NOV-17
STEROLS-SOX-MS-VA	**Soil**							
Batch R3893768								
WG2660089-3 DUP		**L2016641-2**						
Coprostanol		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-NOV-17
Cholestanol		0.074	0.095		mg/kg	25	50	23-NOV-17
WG2660089-1 MB								
Coprostanol			<0.050		mg/kg		0.05	23-NOV-17
Cholestanol			<0.050		mg/kg		0.05	23-NOV-17
TCOLI-DRY-MTF-VA	**Soil**							
Batch R3878758								
WG2654668-1 DUP		**L2016641-19**						
Coliform Bacteria - Total		4	2		MPN/g	59	65	01-NOV-17
WG2654668-2 MB								
Coliform Bacteria - Total			<2		MPN/g		2	01-NOV-17

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Bacteriological Tests							
Fecal coliform by MPN							
	2	30-OCT-17	01-NOV-17 15:30	48	52	hours	EHTR
	16	31-OCT-17 14:30	03-NOV-17 17:00	48	74	hours	EHT
Total coliform by MPN							
	2	30-OCT-17	01-NOV-17 15:30	48	52	hours	EHTR
	16	31-OCT-17 14:30	03-NOV-17 17:00	48	74	hours	EHT
Miscellaneous							
Sterols by GCMS							
	2	30-OCT-17	08-NOV-17 16:53	7	9	days	EHT
	4	31-OCT-17 09:20	08-NOV-17 16:53	7	8	days	EHT
	5	31-OCT-17 09:20	08-NOV-17 16:53	7	8	days	EHT
	7	31-OCT-17 10:30	08-NOV-17 16:53	7	8	days	EHT
	10	31-OCT-17 12:15	08-NOV-17 16:53	7	8	days	EHT
	11	31-OCT-17 12:15	08-NOV-17 16:53	7	8	days	EHT
	16	31-OCT-17 14:30	08-NOV-17 16:53	7	8	days	EHT
	17	31-OCT-17 14:30	08-NOV-17 16:53	7	8	days	EHT
	19	31-OCT-17 15:40	08-NOV-17 16:53	7	8	days	EHT

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2016641 were received on 01-NOV-17 12:50.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Golder Associates
200 – 2920 Virtual Way
Vancouver, British Columbia, Canada V5M 0C4
Telephone (604) 296-4200 Fax (604) 298-5253

CHAIN OF CUSTODY RECORD/ANALYSIS REQUEST

Project Number: 1657231
Short Title: Skagway OKE basin
Golder Contact: Tamara Reynolds
Golder E-mail Address 1: tamara.reynolds@golder.com
Golder E-mail Address 2: eliane-ray @golder.com

Laboratory Name: ALS
Address: Vancouver
Telephone/Fax:
Contact: Amber S.

Office Name: Whitehorse

EQuIS Facility Code: ______
EQuIS upload: ☐

Turnaround Time: ☐ 24 hr ☐ 48 hr ☐ 72 hr ☐ Regular (5 Days)
Criteria: ☐ CSR ☐ CCME ☐ BC Water Quality ☐ Other

Note: Final Reports to be issued by e-mail

Quote No.:

Analyses Required

Tamara will contact BD. Wednesday morning.

Sample Control Number (SCN)	Sample Location	Sa. #	Sample Depth (m)	Sample Matrix (over)	Date Sampled (D/M/Y)	Time Sampled (HH:MM)	Sample Type (over)	QAQC Code (over)	Related SCN (over)	Number of Containers	Metals (CCME)	PAH	Total & Fecal Coliform	Coprostanol	Cholesterol						RUSH (Select TAT above)	Remarks (over)
~~7978-01~~	NOT SUBMITTED																					
~~-02~~	- -	- -	- -	-																		
7978-03	6D			SE	30 OCT	—	SS			2	✓											
-04	6M				..	—				2	✓	✓	✓	✓								
-05	10D				31 OCT	920				2	✓											
-06	10M					920		FDA	7978-08	2	✓	✓	✓	✓								
-07	10S					920				2	✓	✓	✓	✓								
-08	10M					920		FD	7978-06	2	✓											
-09	9M					1030				2	✓	✓	✓	✓								
-10	9D					1030				2	✓											
-11	8D					1235				2	✓											
-12	8M					1215				2	✓		✓	✓								

Sampler's Signature: EC
Relinquished by: Signature EC | Company: Golder | Date: Nov. 1 | Time: 6am
Received by: Signature | Company
Comments: Bacte. Samples. Time sensitive.
Method of Shipment: Air | Waybill No.:
Received for Lab by: | Date | Time
Shipped by: Air North. | Shipment Condition: Seal Intact:
Temp (°C) | Cooler opened by: | Date | Time

WHITE: Golder Copy YELLOW: Lab Copy

ESED

Golder Associates

200 – 2920 Virtual Way
Vancouver, British Columbia, Canada V5M 0C4
Telephone (604) 296-4200 Fax (604) 298-5253

CHAIN OF CUSTODY RECORD/ANALYSIS REQUEST

No. 07979 page 2

Project Number: Same 25 p.1		Laboratory Name: Same 25 p.1	
Short Title:	Golder Contact:	Address:	
Golder E-mail Address 1: @golder.com	Golder E-mail Address 2: @golder.com	Telephone/Fax:	Contact:

Office Name: Whitehorse

EQuIS Facility Code: ______
EQuIS upload: ☐

Turnaround Time: ☐ 24 hr ☐ 48 hr ☐ 72 hr ☐ Regular (5 Days)
Criteria: ☐ CSR ☐ CCME ☐ BC Water Quality ☐ Other

Note: Final Reports to be issued by e-mail

Quote No.:

Analyses Required

Sample Control Number (SCN)	Sample Location	Sa. #	Sample Depth (m)	Sample Matrix (over)	Date Sampled (D / M / Y)	Time Sampled (HH:MM)	Sample Type (over)	QAQC Code (over)	Related SCN (over)	Number of Containers	Metals (CCME)	PAH	Total + Fecal Coliform	Coprostanol Cholestanol						RUSH (Select TAT above)	Remarks (over)
7979 -01	8S			SE	31 OCT	1215	SS			2	✓	✓	✓	✓							
-02	3M					1330		FDA	7979-05	2	✓	✓									
-03	3D					1330				2	✓										
-04	3S					1330				2	✓	✓									
-05	3M					1330		FD	7979-02	2	✓	✓									
-06	4M					1430				2	✓		✓	✓							
-07	4S					1430				2	✓		✓	✓							
-08	4D					1430				2	✓										
-09	7S					1540				2	✓	✓	✓	✓							
-10	7M					1540				2	✓	✓									
-11	7D					1540				2	✓										
-12	5M					1700				2	✓	✓									

Sampler's Signature: ER	Relinquished by: Signature ER	Company Golder	Date Nov 1	Time @ 6pm	Received by: Signature	Company
Comments: Back. samples Time sensitive	Method of Shipment: Air	Waybill No.:		Received for Lab by:	Date	Time
	Shipped by: Air North	Shipment Condition: Seal Intact:		Temp (°C) / Cooler opened by:	Date	Time

WHITE: Golder Copy YELLOW: Lab Copy

Golder Associates

200 – 2920 Virtual Way
Vancouver, British Columbia, Canada V5M 0C4
Telephone (604) 296-4200 Fax (604) 298-5253

CHAIN OF CUSTODY RECORD/ANALYSIS REQUEST

No. 7980 07853 page 3 of

Project Number: Same 25 p. 1
Short Title:
Golder Contact:
Golder E-mail Address 1: @golder.com
Golder E-mail Address 2: @golder.com
Laboratory Name: Same 25 p. 1
Address:
Telephone/Fax:
Contact:

Office Name: Whitehorse

EQuIS Facility Code:
EQuIS upload: ☐

Turnaround Time: ☐ 24 hr ☐ 48 hr ☐ 72 hr ☐ Regular (5 Days)
Criteria: ☐ CSR ☐ CCME ☐ BC Water Quality ☐ Other

Note: Final Reports to be issued by e-mail

Quote No.:

Analyses Required

Sample Control Number (SCN)	Sample Location	Sa. #	Sample Depth (m)	Sample Matrix (over)	Date Sampled (D / M / Y)	Time Sampled (HH:MM)	Sample Type (over)	QAQC Code (over)	Related SCN (over)	Number of Containers	Metals (CCME)	PAH	Total r Fecal Coliforms	Coprostanol Cholesterol	RUSH (Select TAT above)	Remarks (over)
7980 - 01	SS			SE	31 OCT	17:00	SS			2	✓	✓				
- 02	SD			↓		17:00	↓			2	✓					
- 03																
- 04																
- 05																
- 06																
- 07																
- 08																
- 09																
- 10																
- 11																
- 12																

Sampler's Signature: EK
Relinquished by: Signature: EK
Company: Golder
Date: Nov 1.
Time: @ 1pm
Received by: Signature
Company

Comments: Bacti. samples Time sensitive
Method of Shipment: Air
Waybill No.:
Received for Lab by:
Date
Time

Shipped by: Air North.
Shipment Condition:
Seal Intact:
Temp (°C)
Cooler opened by:
Date
Time

WHITE: Golder Copy YELLOW: Lab Copy

Laboratory Data Review Checklist

Completed by: Erin Adshead

Title: Environmental Geoscientist Date: July 13, 2018

CS Report Name: Ore Basin Drilling Investigation Report Date: July 13, 2018

Consultant Firm: Golder Associates Ltd.

Laboratory Name: ALS Environmental Laboratory Report Number: L2016641

ADEC File Number: 1526.38.004 ADEC Harzard ID:

1. Laboratory
   a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

   b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?
      ☐Yes ☐ No ☐**NA** (Please explain.) Comments:

      Samples were not transferred to another laboratory.

2. Chain of Custody (COC)
   a. COC information completed, signed, and dated (including released/received by)?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

   b. Correct analyses requested?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

      Sterols results added 24 November 2017

3. Laboratory Sample Receipt Documentation
   a. Sample/cooler temperature documented and within range at receipt (4° ± 2°C)?
      ☐Yes ☐ **No** ☐NA (Please explain.) Comments:

b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

☒ **Yes** ☐ No ☐ NA (Please explain.) Comments:

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

☒ **Yes** ☐ No ☐ NA (Please explain.) Comments:

Samples arrived in good condition and properly documented by the laboratory.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

☒ **Yes** ☐ No ☐ NA (Please explain.) Comments:

e. Data quality or usability affected? (Please explain.)

Comments:

Data quality unaffected.

4. <u>Case Narrative</u>

a. Present and understandable?

☐ **Yes** ☒ No ☐ NA (Please explain.) Comments:

Reference information included for data qualifiers, and Quality Control Report. This is considered sufficient for QAQC purposes.

b. Discrepancies, errors or QC failures identified by the lab?

☒ **Yes** ☐ No ☐ NA (Please explain.) Comments:

1) The detection limit was raised for select PAH parameters as a results of chromatographic interference due to co-elution.
2) Coliform Fecal and total parameters were received outside of the laboratory holding times for one sample (7979-06).
3) Several laboratory duplicate samples were outside the ALS data quality objectives (DQO) due to sample heterogeneity for metals and select PAH (Hg, Sb, As, Pb, Mo, Sn, U, benz (a) anthracene, dibenz (a,h) anthracene, fluoranthene and fluorine.

c. Were all corrective actions documented?

☒ **Yes** ☐ No ☐ NA (Please explain.) Comments:

Yes, detection limit was raised due to co-elution.

d. What is the effect on data quality/usability according to the case narrative?

Data is considered usable for the purposes of this report.

Comments:

5. Samples Results
   a. Correct analyses performed/reported as requested on COC?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

   b. All applicable holding times met?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

Hold times were exceeded for fecal coliforms and total coliforms for two samples, and for sterols analysis of 9 samples. Hold time were only marginally exceeded, in the case of coliforms the hold times were exceeded by 4 hrs and 26 hours respectively. In the case of Sterols analysis exceeded hold times by 1 to 2 days.

   c. All soils reported on a dry weight basis?
      ☐Yes ☐ No ☐**NA** (Please explain.) Comments:

   d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

yes

   e. Data quality or usability affected?
      Comments:

Practical Quantitation Limit (PQL)/ Method Reporting Limit (MRL) sufficient for assessment.

6. QC Samples
   a. Method Blank
      i. One method blank reported per matrix, analysis and 20 samples?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

      ii. All method blank results less than PQL?
      ☐**Yes** ☐ No ☐NA (Please explain.) Comments:

      iii. If above PQL, what samples are affected?

All method blank results were non-detect (ND) by the laboratory.

Comments:

iv. Do the affected sample(s) have data flags and if so, are the data flags clearly defined?
☐Yes ☐ No ☐**NA** (Please explain.) Comments:

No samples affected.

v. Data quality or usability affected? (Please explain.)
Comments:

Data quality not affected.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

LCS/LCSD reported as per AK methods for organics, all results met acceptable criteria.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?
☐Yes ☐ No ☐**NA** (Please explain.) Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/MSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

4) RPDs for MS/MSD were greater than laboratory DQOs for (Hg, Sb, As, Pb, Mo, Sn, U, benz (a) anthracene, dibenz (a,h) anthracene, fluoranthene and fluorine.

v. If %R or RPD is outside of acceptable limits, what samples are affected?
Comments:

L2016641-1, L2016641-3 through -6; L20166414-8 through -23

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?
☐Yes ☐ No ☐**NA** (Please explain.) Comments:

vii. Data quality or usability affected? (Use comment box to explain.)
Comments:

Data quality not affected. Indication of sample heterogeneity

c. Surrogates – Organics Only

i. Are surrogate recoveries reported for organic analyses – field, QC and laboratory samples?
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?
☐Yes ☐ No ☐**NA** (Please explain.) Comments:

Surrogate recoveries met acceptable criteria by laboratory.

iv. Data quality or usability affected? (Use the comment box to explain.)
Comments:

Data quality not affected.

d. Trip blank – Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

☐**Yes** ☐ No ☐NA (Please explain.) Comments:

No trip blank collected

iii. All results less than PQL?
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?
Comments:

v. Data quality or usability affected? (Please explain.)
Comments:

Volatiles not analyzed therefore not considered to have a significant effect on the quality of results.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?
☐**Yes** ☐ No ☐NA (Please explain.) Comments:

ii. Submitted blind to lab?
☐ **Yes** ☐ No ☐NA (Please explain.) Comments:

iii. Precision – All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1+R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

☐Yes ☐ **No** ☐NA (Please explain.) Comments:

Duplicate pairs reported several analytes outside Golder DQOs, RPDs above 20%: This is indicative of sample matrix heterogeneity and reflective of the composite method of sample collection.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

These results will affect the interpretation of the data set.

Comments:

f. Decontamination or Equipment Blank (If not used explain why).

☐**Yes** ☐ No ☐NA (Please explain.) Comments:

Given the nature of the sampling program (composite samples from split spoons) and equipment blank was not collected. Drill spoons were decontaminated prior to sample collection.

i. All results less than PQL?

☐**Yes** ☐ No ☐NA (Please explain.) Comments:

ii. If above PQL, what samples are affected?

Comments:

iii. Data quality or usability affected? (Please explain.)

Comments:

7. <u>Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)</u>

a. Defined and appropriate?

☐**Yes** ☐ No ☐NA (Please explain.) Comments:

GOLDER

golder.com

APPENDIX E

Supplemental Information for Risk Assessment

GOLDER ASSOCIATES LTD.
ATTN: Vance Mercer
203, 170 Titanium Way
Whitehorse YT Y1A 0G1

Date Received: 26-JUL-17
Report Date: 01-SEP-17 12:48 (MT)
Version: FINAL

Client Phone: 867-334-7423

Certificate of Analysis

Lab Work Order #: L1964789
Project P.O. #: NOT SUBMITTED
Job Reference: 1657231
C of C Numbers: 07908
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1964789-1	L1964789-2	L1964789-3	L1964789-4	L1964789-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	04-MAY-17	29-APR-17	02-MAY-17	26-APR-17	25-APR-17
	Sampled Time					
	Client ID	07908-01	07908-02	07908-03	07908-04	07908-05
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	24.8	45.6	34.6	20.2	23.0
Miscellaneous	Coprostanol (mg/kg)	0.355	0.216	0.270	<0.050	0.075

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1964789-6	L1964789-7	L1964789-8	L1964789-9	L1964789-10
		Description	SE	SE	SE	SE	SE
		Sampled Date	04-MAY-17	30-APR-17	01-MAY-17	02-MAY-17	05-MAY-17
		Sampled Time					
		Client ID	07908-06	07908-07	07908-08	07908-09	07908-10
Grouping	**Analyte**						
SOIL							
Physical Tests	Moisture (%)		16.5	19.6	46.7	21.9	14.9
Miscellaneous	Coprostanol (mg/kg)		<0.050	<0.050	<0.10 DLCI	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLCI	Detection Limit Raised: Chromatographic Interference due to co-elution.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-VA	Soil	Moisture content	CWS for PHC in Soil - Tier 1
This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.			
STEROLS-SOX-MS-VA	Soil	Sterols by GCMS	EPA 3570 & 8270 / J. OF CHROM. 1108

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

07908

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1964789 Report Date: 01-SEP-17

Client: GOLDER ASSOCIATES LTD.
203, 170 Titanium Way
Whitehorse YT Y1A 0G1

Contact: Vance Mercer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-VA	**Soil**							
Batch R3786288								
WG2582197-2 LCS								
Moisture			99.7		%		90-110	31-JUL-17
WG2582197-6 LCS								
Moisture			99.6		%		90-110	31-JUL-17
WG2582197-1 MB								
Moisture			<0.25		%		0.25	31-JUL-17
WG2582197-5 MB								
Moisture			<0.25		%		0.25	31-JUL-17
STEROLS-SOX-MS-VA	**Soil**							
Batch R3816846								
WG2604838-3 DUP		**L1964789-5**						
Coprostanol		0.075	<0.050	RPD-NA	mg/kg	N/A	50	01-SEP-17
WG2604838-1 MB								
Coprostanol			<0.050		mg/kg		0.05	01-SEP-17

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Moisture content							
	1	04-MAY-17	31-JUL-17 08:26	14	88	days	EHTR
	2	29-APR-17	31-JUL-17 08:26	14	93	days	EHTR
	3	02-MAY-17	31-JUL-17 08:26	14	90	days	EHTR
	4	26-APR-17	31-JUL-17 08:26	14	96	days	EHTR
	5	25-APR-17	31-JUL-17 08:26	14	97	days	EHTR
	6	04-MAY-17	31-JUL-17 08:26	14	88	days	EHTR
	7	30-APR-17	31-JUL-17 08:26	14	92	days	EHTR
	8	01-MAY-17	31-JUL-17 08:26	14	91	days	EHTR
	9	02-MAY-17	31-JUL-17 08:26	14	90	days	EHTR
	10	05-MAY-17	31-JUL-17 08:26	14	87	days	EHTR
Miscellaneous							
Sterols by GCMS							
	1	04-MAY-17	28-AUG-17 15:34	7	116	days	EHTR
	2	29-APR-17	28-AUG-17 15:34	7	121	days	EHTR
	3	02-MAY-17	28-AUG-17 15:34	7	118	days	EHTR
	4	26-APR-17	28-AUG-17 15:34	7	124	days	EHTR
	5	25-APR-17	28-AUG-17 15:34	7	125	days	EHTR
	6	04-MAY-17	28-AUG-17 15:34	7	116	days	EHTR
	7	30-APR-17	28-AUG-17 15:34	7	120	days	EHTR
	8	01-MAY-17	28-AUG-17 15:34	7	119	days	EHTR
	9	02-MAY-17	28-AUG-17 15:34	7	118	days	EHTR
	10	05-MAY-17	28-AUG-17 15:34	7	115	days	EHTR

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1964789 were received on 26-JUL-17 10:40.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Golder Associates

200 – 2920 Virtual Way
Vancouver, British Columbia, Canada V5M 0C4
Telephone (604) 296-4200 Fax (604) 298-5253

CHAIN OF CUSTODY RECORD

L1964789-COFC

No. 07908 page 1 of 1

Project Number: 1657231

Short Title: WPYR Ore Basin Sediment

Golder Contact: Vince Mercer

ALS

Address: Burnaby

Golder E-mail Address 1: Vance_mercer @golder.com

Golder E-mail Address 2: Blair-McDonald @golder.com

Telephone/Fax: 604.253.4188

Contact: Joanne Lee

Office Name: Whitehorse

EQuIS Facility Code:

EQuIS upload: ☐

Turnaround Time: ☐ 24 hr ☐ 48 hr ☐ 72 hr ☒ Regular (5 Days)

Criteria: ☐ CSR ☐ CCME ☐ BC Water Quality ☐ Other

Quote No.:

Note: Final Reports to be issued by e-mail

Analyses Required

Sample Control Number (SCN)	Sample Location	Sa. #	Sample Depth (m)	Sample Matrix (over)	Date Sampled (D / M / Y)	Time Sampled (HH:MM)	Sample Type (over)	QAQC Code (over)	Related SCN (over)	Number of Containers	Coprostanol									RUSH (Select TAT above)	Remarks (over)
7908 - 01	SED-17-01	–		SE	4 May		Grab.			1	X										
- 02	SED-17-13	–			29 APR																
- 03	SED-17-18	–			2 MAY																
- 04	SED-17-06	–			26 APR																
- 05	SED-17-05	–			25 APR																
- 06	SED-17-03	–			4 MAY																
- 07	SED-17-11	–			30 APR																
- 08	SED-17-20	–			1 MAY																
- 09	SED-17-24	–			2 MAY																
- 10	SED-17-27	–			5 May																
- 11																					
- 12																					

Sampler's Signature:	Relinquished by: Signature EC	Company: Golder	Date: July 26	Time: 1030	Received by: Signature	Company
Comments:	Method of Shipment: hand del	Waybill No.:	Received for Lab by: EHF		Date: 26 July 2017	Time: 10:40
	Shipped by:	Shipment Condition: Seal Intact:	Temp (°C): 9.0	Cooler opened by:	Date	Time

WHITE: Golder Copy YELLOW: Lab Copy

Alex 27/07/2017 12:20

4.9/5.7/6.1

ESED

Results Summary L1964789

Job Reference 1657231
Report To Vance Mercer, GOLDER ASSOCIATES LTD.
Date Received 26-Jul-2017 10:40
Report Date 1-Sep-2017 12:48
Report Version 1

Golder ID	Sample Location	Sample Date	ALS ID	Coprostanol (mg.kg)
07908-01	SED17-01	4-May-2017	L1964789-1	0.355
07908-02	SED17-13	29-Apr-2017	L1964789-2	0.216
07908-03	SED17-18	2-May-2017	L1964789-3	0.270
07908-04	SED17-06	26-Apr-2017	L1964789-4	<0.050
07908-05	SED17-05	25-Apr-2017	L1964789-5	0.075
07908-06	SED17-03	4-May-2017	L1964789-6	<0.050
07908-07	SED17-11	30-Apr-2017	L1964789-7	<0.050
07908-08	SED17-20	1-May-2017	L1964789-8	<0.10
07908-09	SED17-24	2-May-2017	L1964789-9	<0.050
07908-10	SED17-27	5-May-2017	L1964789-10	<0.050

SPEARMAN RANK CORRELATION TABLES GENERATED FROM THE PRINCIPLE COMPONENTS ANALYSIS (PCA) OF SEDIMENT DATA

Data from the June 2017 Sampling Program

Metals

Parameter	METALSPC1	METALSPC2
Aluminum (Al)	**0.865**	**0.428**
Arsenic (As)	**0.931**	0.201
Barium (Ba)	**0.955**	0.257
Beryllium (Be)	**0.894**	0.259
Cadmium (Cd)	**0.873**	-0.217
Calcium (Ca)	**0.58**	0.357
Chromium (Cr)	**0.913**	0.353
Cobalt (Co)	**0.955**	0.318
Copper (Cu)	0.267	**-0.8**
Iron (Fe)	**0.931**	0.087
Lead (Pb)	0.175	**-0.913**
Magnesium (Mg)	**0.958**	0.28
Manganese (Mn)	**0.974**	0.103
Mercury (Hg)	0.194	**-0.848**
Nickel (Ni)	**0.904**	0.23
Potassium (K)	**0.945**	0.243
Silver (Ag)	**0.771**	-0.356
Sodium (Na)	**0.907**	0.381
Thallium (Tl)	**0.967**	0.217
Vanadium (V)	**0.913**	0.263
Zinc (Zn)	**0.509**	**-0.691**

Notes
Significant correlations ($p<0.05$; n= 24; r_s = 0.406) are bold
Strong correlations ($p<0.001$; n= 24; r_s = 0.642) are bold and gray shaded

PAHs

Parameter	PAHSPC1
Anthracene	**0.956**
Fluorene	**0.738**
Phenanthrene	**0.952**
Benzo(a)anthracene	**0.968**
Benzo(a)pyrene	**0.962**
Benzo(b)fluoranthene	**0.961**
Benzo(g,h,i)perylene	**0.944**
Benzo(k)fluoranthene	**0.963**
Chrysene	**0.971**
Fluoranthene	**0.978**
Indeno(1,2,3-c,d)pyrene	**0.968**
Pyrene	**0.977**
Total benzofluoranthenes	**0.964**
Total LPAH	**0.951**
Total HPAH	**0.994**

Notes
Significant correlations ($p<0.05$; $n= 24$; $r_s = 0.406$) are bold
Strong correlations ($p<0.001$; $n= 24$; $r_s = 0.642$) are bold and gray shaded

Conventional Parameters

Paramter	CONVPC1	CONVPC2
Ps	**0.934**	0.003
Toc	**-0.832**	-0.021
Clay	**-0.81**	-0.097
Silt	**-0.944**	0.055
Sand__very_fine	-0.169	**-0.68**
Sand__fine	**0.463**	**-0.772**
Sand__medium	**0.714**	-0.306
Sand__coarse	**0.877**	-0.039
Sand__very_coarse	**0.821**	0.304
Gravel__fine	**0.528**	**0.777**
Gravel__medium	**0.582**	**0.494**

Notes
Significant correlations ($p<0.05$; $n= 24$; $r_s = 0.406$) are bold
Strong correlations ($p<0.001$; $n= 24$; $r_s = 0.642$) are bold and gray shaded

Data from the June and October 2017 Sampling Programs Combined

Metals

Parameter	METALSPC1	METALSPC2
Antimony (Sb)	**0.497**	0.179
Arsenic (As)	**0.986**	**-0.535**
Barium (Ba)	**0.781**	**-0.879**
Beryllium (Be)	**0.82**	**-0.809**
Cadmium (Cd)	**0.861**	-0.238
Chromium (Cr)	**0.779**	**-0.894**
Cobalt (Co)	**0.868**	**-0.788**
Copper (Cu)	**0.817**	-0.257
Lead (Pb)	**0.551**	0.163
Mercury (Hg)	**0.586**	0.105
Nickel (Ni)	**0.763**	**-0.876**
Silver (Ag)	**0.82**	-0.173
Thallium (Tl)	**0.969**	**-0.471**
Vanadium (V)	**0.803**	**-0.853**
Zinc (Zn)	**0.674**	0.013

Notes
Significant correlations ($p<0.05$; n= 50; r_s = 0.279) are bold
Strong correlations ($p<0.001$; n= 50; r_s = 0.456) are bold and gray shaded

PAHs

Parameter	PAHSPC1
Anthracene	**0.986**
Phenanthrene	**0.983**
Benzo(a)anthracene	**0.991**
Benzo(a)pyrene	**0.99**
Benzo(b)fluoranthene	**0.989**
Benzo(g,h,i)perylene	**0.983**
Benzo(k)fluoranthene	**0.989**
Chrysene	**0.991**
Fluoranthene	**0.99**
Indeno(1,2,3-c,d)pyrene	**0.991**
Pyrene	**0.983**
Total benzofluoranthenes	**0.9**
Total LPAH	**0.826**
Total HPAH	**0.931**

Notes
Significant correlations ($p<0.05$; n= 50; r_s = 0.279) are bold
Strong correlations ($p<0.001$; n= 50; r_s = 0.456) are bold and gray shaded

SYSTAT 13 RAW OUTPUT FROM THE PCA OF SEDIMENT DATA

SYSTAT 13 PCA Output of Metals Data from the June 2017 Sampling Program

Latent Roots (Eigenvalues)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
14.170	3.875	0.899	0.586	0.472	0.410	0.185	0.125	0.090	0.055	0.048	0.033	0.020	0.010	0.008	0.006	0.004	0.002	0.001	0.000	0.000

Component Loadings

	1	2
AL	0.885	0.303
AS	0.916	0.074
BA	0.954	0.156
BE	0.927	0.224
CD	0.756	-0.573
CA	0.530	0.250
CR	0.936	0.184
CO	0.965	0.158
CU	0.238	-0.799
FE	0.939	-0.086
PB	0.254	-0.935
MG	0.962	0.185
MN	0.981	-0.057
HG	0.338	-0.870
NI	0.894	0.020
K	0.954	0.134
AG	0.674	-0.374
NA	0.931	0.235
TI	0.965	0.103
V	0.936	0.198
ZN	0.527	-0.822

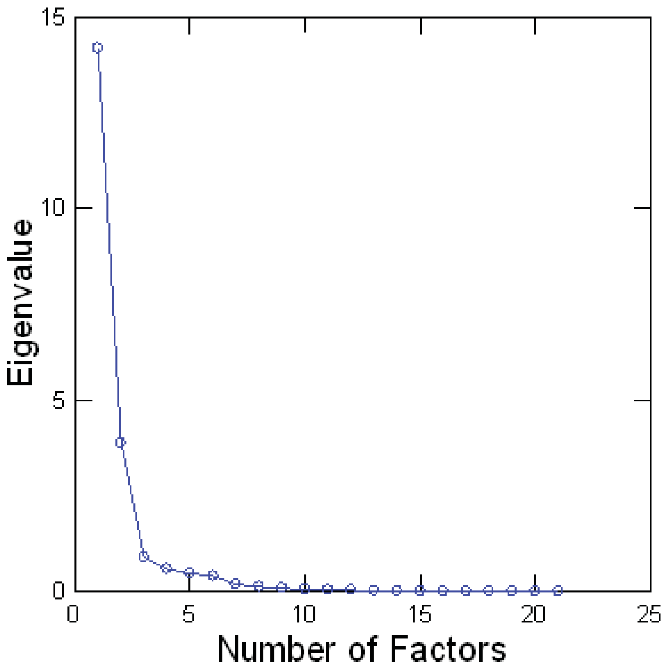
Variance Explained by Components

1	2
14.170	3.875

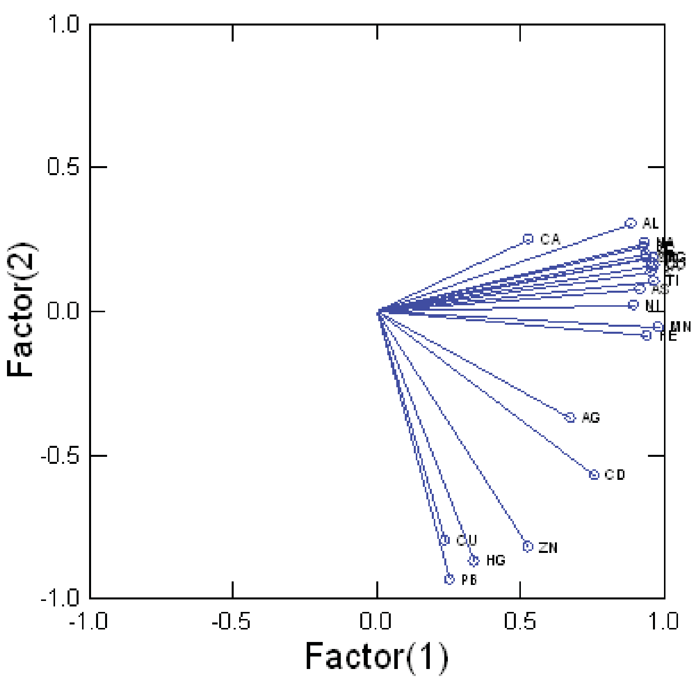
Percent of Total Variance Explained

1	2
67.476	18.452

Scree Plot



Factor Loadings Plot



Golder Associates

Dimensional Scores Generated During the PCA

Station ID	MetalsPC1	MetalsPC2	Tsquare	Prob
SED17-07	-3.269812141	-1.00949426	1.017535	0.621146
SED17-11	-4.625023192	-0.65371687	1.619887	0.472998
SED17-12	0.616094604	-4.32305933	4.849937	0.121882
SED17-13	6.768451553	-2.4848211	4.8265	0.123016
SED17-06	-3.731414995	-0.21830303	0.994908	0.627619
SED17-08	-1.267203472	-3.18867468	2.737355	0.290271
SED17-09	5.494997979	-4.37405393	7.068536	0.052453
SED17-10	-4.276646028	-0.49875306	1.354942	0.53278
SED17-14	-1.843062243	-0.77146594	0.393322	0.829842
SED17-05	-1.583294232	-0.00097385	0.176912	0.919168
SED17-17	-0.717878156	-0.0257223	0.03654	0.98269
SED17-18	1.174457939	0.026226	0.097521	0.954524
SED17-01	1.447020201	0.98202835	0.396653	0.828543
SED17-03	-5.991287294	0.70223959	2.660495	0.299979
SED17-15	-3.37516724	0.37616434	0.840459	0.673822
SED17-19	1.114388428	1.06338226	0.379469	0.835267
SED17-20	5.059886562	1.27119897	2.22386	0.362309
SED17-21	3.872980286	1.67996403	1.786945	0.43909
SED17-22	2.125296586	0.58987159	0.408564	0.823917
SED17-24	-1.870058162	1.82806987	1.109249	0.595642
SED17-27	-4.644095742	1.38893723	2.019942	0.396147
SED17-28	-0.883862548	2.05157449	1.141365	0.586984
SED17-29	4.981009992	2.76425115	3.722913	0.191993
SED17-31	5.424221312	2.82513045	4.13619	0.162169

SYSTAT 13 PCA Output of PAH Data from the June 2017 Sampling Program

Latent Roots (Eigenvalues)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
14.248	0.365	0.189	0.076	0.058	0.024	0.013	0.011	0.008	0.004	0.003	0.001	0.000	0.000	0.000

Component Loadings

	1
ANTHRACENE	0.975
FLUORENE	0.945
PHEN	0.976
BAANTH	0.994
BAP	0.992
BENZBF	0.990
BENZGHIP	0.970
BENZKF	0.992
CHRY	0.988
FLUORANT	0.954
INDENO	0.976
PYRENE	0.986
TBENZOFLUO	0.982
LPAH	0.951
HPAH	0.946

Variance Explained by Components

14.248

Percent of Total Variance Explained

94.988

Dimensional Scores Generated During the PCA

Station ID	PAHsPC1	Tsquare	Prob
SED17-07	-1.25603	0.110724	0.742335
SED17-11	-1.38444	0.134519	0.717144
SED17-12	1.50969	0.159961	0.692883
SED17-13	10.6217	7.918216	0.009849
SED17-06	-1.71567	0.206589	0.653715
SED17-08	-0.61542	0.026581	0.871913
SED17-09	10.78468	8.163068	0.008916
SED17-10	0.10178	0.000727	0.978721
SED17-14	0.723296	0.036717	0.849723
SED17-05	-0.30446	0.006506	0.936411
SED17-17	-0.04898	0.000168	0.989758
SED17-18	2.710972	0.515809	0.479867
SED17-01	-2.12866	0.318018	0.578259
SED17-03	-3.18548	0.712179	0.407413
SED17-15	-0.90708	0.057748	0.812221
SED17-19	3.706955	0.964436	0.33629
SED17-20	0.121724	0.00104	0.974553
SED17-21	-2.27091	0.361942	0.553314
SED17-22	-1.63992	0.18875	0.668008
SED17-24	-3.2111	0.723681	0.403709
SED17-27	-3.23452	0.734274	0.400342
SED17-28	-3.17056	0.70552	0.409582
SED17-29	-2.69523	0.509837	0.482393
SED17-31	-2.51233	0.442988	0.512304

SYSTAT 13 PCA Output of Physical Parameter Data from the June 2017 Sampling Program

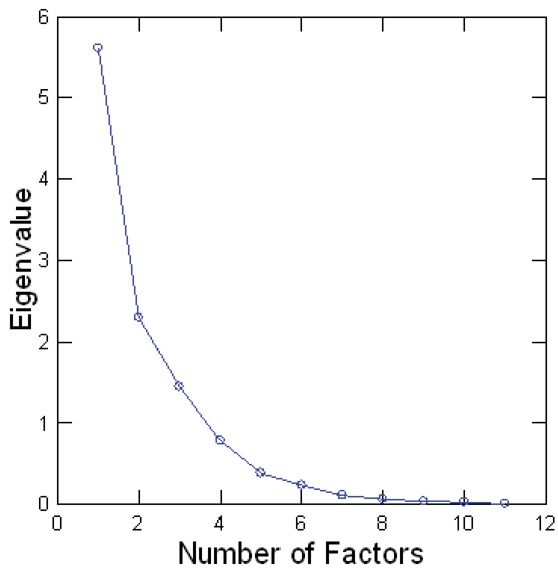
Latent Roots (Eigenvalues)										
1	2	3	4	5	6	7	8	9	10	11
5.611	2.296	1.447	0.783	0.383	0.236	0.110	0.064	0.036	0.027	0.005

Component Loadings	1	2	3
PS	0.889	-0.248	0.254
TOC	-0.816	0.231	-0.167
CLAY	-0.797	-0.024	-0.409
SILT	-0.967	0.046	0.145
SAND__VERY_FINE	-0.140	-0.574	0.770
SAND__FINE	0.421	-0.809	-0.011
SAND__MEDIUM	0.735	-0.355	-0.542
SAND__COARSE	0.860	0.004	-0.412
SAND__VERY_COARSE	0.774	0.329	0.159
GRAVEL__FINE	0.581	0.759	0.164
GRAVEL__MEDIUM	0.411	0.620	0.242

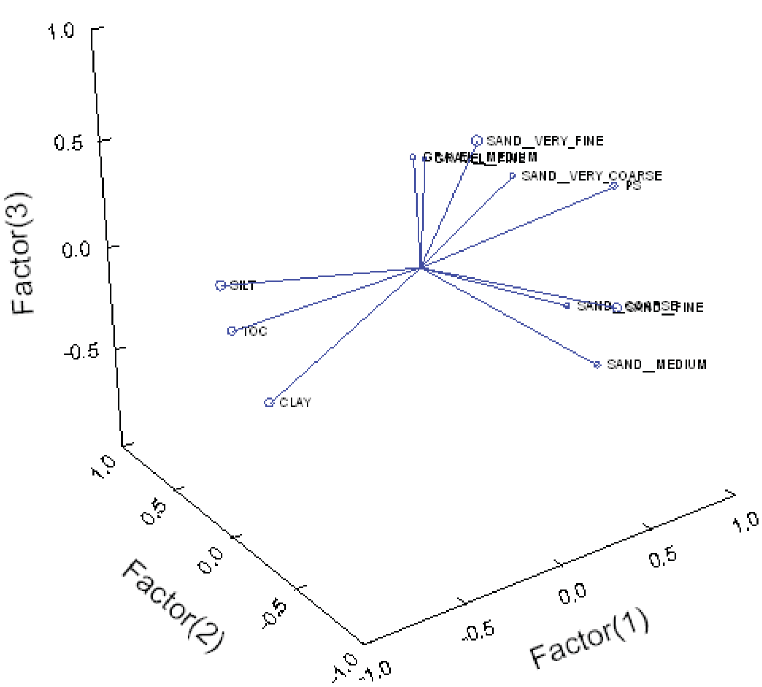
Variance Explained by Components		
1	2	3
5.611	2.296	1.447

Percent of Total Variance Explained		
1	2	3
51.010	20.877	13.153

Scree Plot



Factor Loadings Plot



Dimensional Scores Generated During the PCA

Station ID	ConvPC1	ConvPC2	ConvPC3	Tsquare	Prob
SED17-07	2.482507	2.655209	1.565873	5.863009	0.180983
SED17-11	2.994881	0.503856	0.11286	1.717851	0.671291
SED17-12	2.726145	1.263247	-0.60234	2.27015	0.567749
SED17-13	-2.71913	0.08698	-0.35622	1.40869	0.73452
SED17-06	2.815819	0.759967	0.084967	1.669551	0.680946
SED17-08	1.350455	-1.42873	-0.17487	1.235031	0.771299
SED17-09	-2.24329	-0.1879	-0.62232	1.179907	0.78311
SED17-10	2.452058	-1.81336	-1.84776	4.863199	0.248734
SED17-14	1.507032	-2.06142	-1.44979	3.70792	0.360203
SED17-05	0.176507	-2.12407	0.858489	2.479551	0.531991
SED17-17	0.214407	-1.79453	-0.12215	1.420815	0.731981
SED17-18	-1.05552	-1.05994	0.128724	0.69923	0.886391
SED17-01	-1.24706	-1.40771	0.679805	1.459474	0.723916
SED17-03	3.883884	1.556259	-1.1838	4.711555	0.261099
SED17-15	2.787668	0.261583	-1.05162	2.179104	0.583907
SED17-19	-2.74562	-0.41038	0.124633	1.427561	0.73057
SED17-20	-1.76567	3.022034	0.460788	4.679213	0.263816
SED17-21	-1.86412	0.319696	-0.65392	0.959351	0.830704
SED17-22	-2.32161	0.230373	-0.36258	1.074548	0.805805
SED17-24	-0.37699	-0.61109	0.82365	0.656819	0.89527
SED17-27	1.580844	0.851955	3.246874	8.047707	0.091897
SED17-28	-1.36765	-1.97317	2.499909	6.34814	0.155345
SED17-29	-3.63223	1.297087	-0.91211	3.658877	0.365908
SED17-31	-3.63333	2.06407	-1.24707	5.282747	0.217567

SYSTAT 13 PCA Output of Metals Data from the June and October 2017 Sampling Programs

Matrix to be Factored

	SB	AS	BA	BE	CD	CR	CO	CU	PB	HG	NI	AG	TL	V	ZN
SB	1.000														
AS	0.959	1.000													
BA	-0.017	0.226	1.000												
BE	0.214	0.459	0.905	1.000											
CD	0.976	0.939	-0.012	0.209	1.000										
CR	0.134	0.389	0.874	0.909	0.132	1.000									
CO	0.385	0.611	0.832	0.942	0.384	0.928	1.000								
CU	0.866	0.909	0.221	0.389	0.885	0.330	0.520	1.000							
PB	0.807	0.794	0.150	0.258	0.807	0.148	0.333	0.881	1.000						
HG	0.972	0.934	-0.024	0.197	0.999	0.122	0.374	0.882	0.800	1.000					
NI	0.149	0.395	0.818	0.863	0.146	0.971	0.915	0.328	0.138	0.136	1.000				
AG	0.999	0.965	0.019	0.244	0.975	0.162	0.411	0.881	0.825	0.970	0.175	1.000			
TL	0.993	0.975	0.062	0.299	0.962	0.220	0.471	0.866	0.784	0.957	0.235	0.993	1.000		
V	0.173	0.420	0.926	0.981	0.166	0.932	0.954	0.357	0.205	0.155	0.884	0.203	0.263	1.000	
ZN	0.815	0.821	0.214	0.321	0.833	0.217	0.398	0.891	0.983	0.826	0.213	0.833	0.795	0.264	1.000

Latent Roots (Eigenvalues)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
9.174	4.723	0.602	0.209	0.100	0.074	0.055	0.025	0.021	0.007	0.006	0.003	0.002	0.000	0.000

Empirical Upper Bound for the First Eigenvalue : 10.796

Chi-Square Test that All Eigenvalues are Equal

N : 50.000
Chi-Square : 2,354.926
df : 105.000
p-Value : 0.000

Chi-Square Test that the Last 13 Eigenvalues are Equal

Chi-Square : 1,071.693
df : 93.071
p-Value : 0.000

Latent Vectors (Eigenvectors)		
	1	2
SB	0.295	0.190
AS	0.321	0.073
BA	0.134	-0.392
BE	0.197	-0.353
CD	0.294	0.191
CR	0.173	-0.378
CO	0.239	-0.308
CU	0.305	0.089
PB	0.273	0.147
HG	0.291	0.195
NI	0.172	-0.363
AG	0.300	0.178
TL	0.303	0.149
V	0.186	-0.371
ZN	0.285	0.120

Standard Error for Each Eigenvector Element		
	1	2
SB	0.041	0.063
AS	0.017	0.068
BA	0.084	0.036
BE	0.075	0.044
CD	0.041	0.063
CR	0.080	0.039
CO	0.065	0.051
CU	0.024	0.068
PB	0.038	0.067
HG	0.042	0.063
NI	0.078	0.042
AG	0.038	0.064
TL	0.033	0.066
V	0.078	0.041
ZN	0.033	0.068

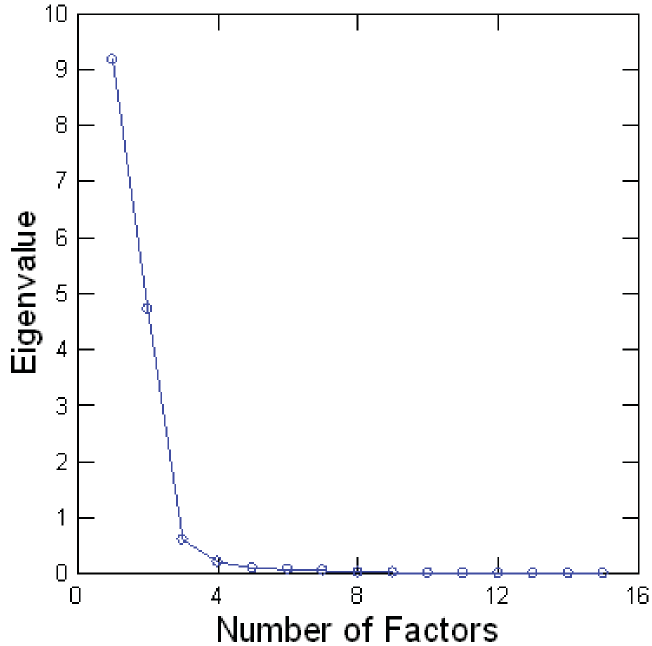
Component Loadings		
	1	2
SB	0.893	0.413
AS	0.972	0.158
BA	0.404	-0.853
BE	0.596	-0.768
CD	0.890	0.415
CR	0.524	-0.822
CO	0.723	-0.670
CU	0.925	0.194
PB	0.828	0.319
HG	0.883	0.423
NI	0.521	-0.789
AG	0.908	0.387
TL	0.918	0.323
V	0.562	-0.807
ZN	0.864	0.261

Variance Explained by Components	
1	2
9.174	4.723

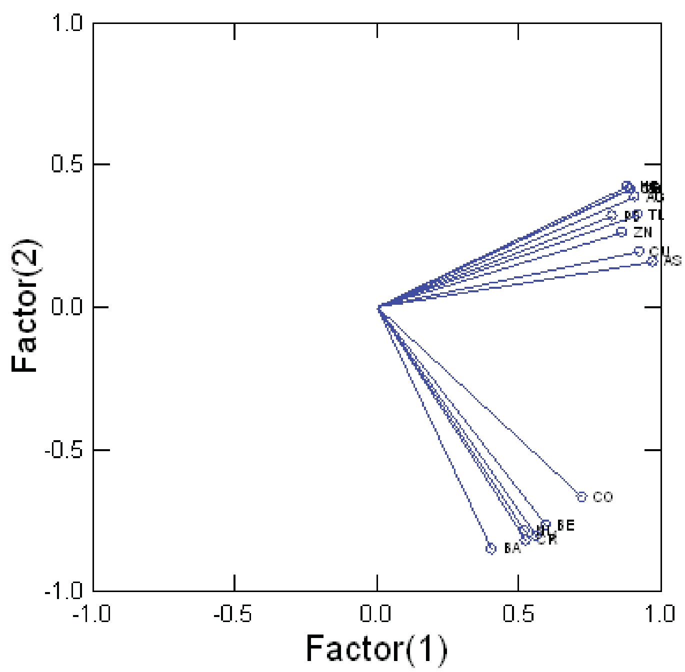
Percent of Total Variance Explained	
1	2
61.159	31.487

Differences: Original Minus Fitted Correlations or Covariances															
	SB	AS	BA	BE	CD	CR	CO	CU	PB	HG	NI	AG	TL	V	ZN
SB	0.033														
AS	0.026	0.029													
BA	-0.026	-0.032	0.109												
BE	0.000	0.001	0.009	0.055											
CD	0.010	0.008	-0.019	-0.003	0.035										
CR	0.006	0.009	-0.039	-0.034	0.006	0.050									
CO	0.016	0.014	-0.032	-0.003	0.018	-0.001	0.028								
CU	-0.039	-0.021	0.012	-0.013	-0.019	0.005	-0.019	0.107							
PB	-0.064	-0.062	0.087	0.009	-0.063	-0.024	-0.053	0.053	0.213						
HG	0.009	0.008	-0.020	-0.004	0.038	0.007	0.019	-0.017	-0.066	0.041					
NI	0.010	0.013	-0.066	-0.053	0.009	0.050	0.010	0.000	-0.041	0.010	0.107				
AG	0.028	0.021	-0.019	0.000	0.006	0.003	0.012	-0.034	-0.051	0.005	0.007	0.026			
TL	0.040	0.031	-0.034	0.000	0.011	0.004	0.023	-0.046	-0.079	0.010	0.011	0.034	0.052		
V	0.004	0.000	0.010	0.026	0.000	-0.026	0.006	-0.007	-0.003	0.000	-0.046	0.004	0.007	0.032	
ZN	-0.064	-0.060	0.087	0.007	-0.044	-0.021	-0.052	0.042	0.184	-0.047	-0.031	-0.053	-0.082	-0.011	0.186

Scree Plot



Factor Loadings Plot



Factor Coefficients		
	1	2
SB	0.097	0.087
AS	0.106	0.033
BA	0.044	-0.181
BE	0.065	-0.163
CD	0.097	0.088
CR	0.057	-0.174
CO	0.079	-0.142
CU	0.101	0.041
PB	0.090	0.067
HG	0.096	0.090
NI	0.057	-0.167
AG	0.099	0.082
TL	0.100	0.068
V	0.061	-0.171
ZN	0.094	0.055

Dimensional Scores Generated During the PCA

Station ID	MetalsPC1	MetalsPC2	Tsquare	Prob
SED17-07	-1.614264762	0.78787093	0.415482	0.816569
SED17-11	-1.817378336	0.97185522	0.560011	0.761294
SED17-12	-0.016179704	-0.68219635	0.098565	0.952916
SED17-13	1.870728206	-3.98578591	3.745098	0.17074
SED17-06	-1.530788563	0.406851	0.290483	0.867745
SED17-08	-0.17869628	-0.08908279	0.005161	0.997475
SED17-09	1.203632018	-2.56894939	1.555221	0.472413
SED17-10	-1.824811167	0.99345797	0.571951	0.756906
SED17-14	-0.936331066	-0.2922566	0.113652	0.945916
SED17-05	-1.174892691	-0.25456269	0.16419	0.922853
SED17-17	-0.771424202	-0.87899701	0.228458	0.894368
SED17-18	-0.075771067	-1.87319304	0.743549	0.696664
SED17-01	0.088876075	-2.64703335	1.484395	0.488578
SED17-03	-2.433475861	1.36694058	1.041133	0.603746
SED17-15	-1.548294215	0.20672809	0.27036	0.876291
SED17-19	-0.426969271	-1.68335042	0.61984	0.739567
SED17-20	0.87764874	-3.86008183	3.238763	0.215217
SED17-21	0.82116873	-3.55092979	2.743207	0.270536
SED17-22	0.031987432	-1.9848753	0.834263	0.666857

Station ID	MetalsPC1	MetalsPC2	Tsquare	Prob
SED17-24	-1.232281906	-0.78897538	0.297325	0.864859
SED17-27	-2.141880713	0.64273865	0.58755	0.751211
SED17-28	-1.116169705	-1.13101209	0.406644	0.820082
SED17-29	0.855280706	-4.09541549	3.630934	0.179854
SED17-31	1.126162199	-4.56423752	4.549023	0.11876
SED17-32S	-1.334243481	-0.08661669	0.195642	0.908797
SED17-32M	-2.373828705	1.610457	1.163389	0.569405
SED17-33S	-0.965351017	-0.39289018	0.134266	0.936437
SED17-33M	-1.253643458	1.07372198	0.415414	0.816596
SED17-34S	2.920737472	-2.0830529	1.848612	0.411157
SED17-34M	2.701502696	-0.52526402	0.853957	0.660564
SED17-34D	-2.61270263	2.26236541	1.827788	0.415219
SED17-35S	7.980432184	0.13853532	6.946377	0.041512
SED17-35M	3.000467467	3.04917409	2.949897	0.245852
SED17-35D	-2.163650465	2.24130293	1.573904	0.468242
SED17-36S	13.3012477	5.19216786	24.99363	5.06E-05
SED17-36M	4.939524605	4.38947689	6.739107	0.04538
SED17-36D	-2.395460677	2.07683083	1.538735	0.476125
SED17-37M	6.61868446	-0.42480369	4.813443	0.105518
SED17-37D	-2.74918005	2.22233353	1.869544	0.407115
SED17-38S	1.795116522	-3.4355343	2.850272	0.257443
SED17-38M	-0.524759249	-0.10239512	0.032237	0.984339
SED17-38D	-2.680701981	1.81437523	1.480337	0.489522
SED17-39S	-2.343223317	1.62959506	1.160781	0.570116
SED17-39M	-1.084103488	0.28433563	0.14523	0.931436
SED17-39D	-3.011276245	2.24950761	2.05985	0.372218
SED17-40M	-2.958374654	2.08205648	1.871854	0.406672
SED17-40D	-2.107399435	1.68161253	1.08284	0.591795
SED17-41S	-1.480165307	0.44385709	0.280533	0.87196
SED17-41M	0.783946229	0.09231305	0.068796	0.966888
SED17-41D	-0.039469771	2.0710309	0.908308	0.643514

SYSTAT 13 PCA Output of PAH Data from the June and October 2017 Sampling Programs

Latent Roots (Eigenvalues)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
13.463	0.281	0.120	0.059	0.030	0.018	0.011	0.010	0.004	0.002	0.001	0.001	0.000	0.000

Component Loadings

	1
ANTHRACENE	0.979
Phenanthrene	0.981
Benzo(a)anthracene	0.996
Benzo(a)pyrene	0.992
Benzo(b)fluoranthene	0.993
Benzo(g,h,i)perylene	0.969
Benzo(k)fluoranthene	0.993
Chrysene	0.992
Fluoranthene	0.966
Indeno(1,2,3-c,d)pyrene	0.974
Pyrene	0.989
Total benzofluoranthenes	0.987
LPAH	0.962
HPAH	0.954

Variance Explained by Components
13.463

Percent of Total Variance Explained
96.166

Dimensional Scores Generated During the PCA

Station ID	PAHsPC1	Tsquare	Prob
SED17-07	0.03364521	8.40808E-05	0.992734
SED17-11	-0.11147511	0.000923009	0.975931
SED17-12	3.05042759	0.691148948	0.411254
SED17-13	12.3924501	11.40681944	0.001769
SED17-06	-0.48538438	0.017499345	0.895495
SED17-08	0.62261497	0.02879316	0.866207
SED17-09	12.7326664	12.04173121	0.001368
SED17-10	1.41672962	0.14908164	0.701687
SED17-14	2.20236326	0.360270015	0.552116

Station ID	PAHsPC1	Tsquare	Prob
SED17-05	1.09504436	0.089066346	0.767083
SED17-17	1.33324101	0.132028454	0.718463
SED17-18	4.19400083	1.306493446	0.260575
SED17-01	-0.95712787	0.068044047	0.795693
SED17-03	-2.1192664	0.333596371	0.567144
SED17-15	0.38174057	0.010823977	0.917716
SED17-19	5.34501948	2.122016686	0.153863
SED17-20	1.30744821	0.126969438	0.723675
SED17-21	-1.15843065	0.099675929	0.754042
SED17-22	-0.41991867	0.013097264	0.909522
SED17-24	-2.15000173	0.34334271	0.561562
SED17-27	-2.17060259	0.349953904	0.557836
SED17-28	-2.11413556	0.33198302	0.568079
SED17-29	-1.63182674	0.197787255	0.659175
SED17-31	-1.4422136	0.154493204	0.696596
SED17-32S	-2.48985038	0.460465092	0.501746
SED17-32M	.	.	.
SED17-33S	-2.48419085	0.458374158	0.502712
SED17-33M	.	.	.
SED17-34S	-2.34110293	0.407090745	0.527488
SED17-34M	-2.1273959	0.336160627	0.565665
SED17-34D	.	.	.
SED17-35S	.	.	.
SED17-35M	.	.	.
SED17-35D	.	.	.
SED17-36S	-2.32186741	0.400428558	0.530867
SED17-36M	-2.37460453	0.41882519	0.521629
SED17-36D	.	.	.
SED17-37M	-2.39155571	0.424826124	0.518679
SED17-37D	.	.	.
SED17-38S	-2.41413973	0.432887473	0.514761
SED17-38M	-2.43230736	0.439427386	0.511621
SED17-38D	.	.	.
SED17-39S	-2.4965053	0.462929861	0.500611
SED17-39M	.	.	.

Station ID	PAHsPC1	Tsquare	Prob
SED17-39D	.	.	.
SED17-40M	-2.49973771	0.464129417	0.50006
SED17-40D	.	.	.
SED17-41S	-2.48335698	0.458066485	0.502855
SED17-41M	-2.49039346	0.460665983	0.501653
SED17-41D	.	.	.

. = a PAH sample was not analysed and so no dimensional scores could be generated

Toxicity Identification Evaluation for Sediment Porewaters SED17-09 and SED17-13

Final Report

January 12, 2018

Submitted to: **Golder Associates Ltd.**
Burnaby, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

TABLE OF CONTENTS

Page

List of Tables

List of Appendices

SIGNATURE PAGE

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Environmental Chemist	Environmental Toxicologist

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the sample tested.

1.0 INTRODUCTION

Whole sediment samples were collected between April 26 and May 5, 2017, and delivered to the Nautilus Environmental laboratory in Burnaby, BC on May 15, 2017. Whole sediment toxicity tests were performed on these samples, including: 96-h echinoderm (*Strongylocentrotus purpuratus*) larval survival and development, 10-d marine amphipod (*Eohaustorius estuarius*) survival and 20-d marine polychaete (*Neanthes arenaceodentata*) survival and growth. Porewaters were also generated from two of the whole sediment samples, using methods described below, and a Toxicity Identification Evaluation (TIE) was conducted on these porewaters using the 96-h echinoderm (*Strongylocentrotus purpuratus*) larval survival and development water-only test.

The samples explored in the TIE, SED17-09 and SED17-13, were observed to cause reduced survival of *Eohaustaurius estuarius* and development of *Strongylocentrotus purpuratus* in the baseline whole sediment testing (Table 1). The porewater TIE was performed to elucidate the cause of this reduced performance.

Table 1. Results: Whole sediment test results for SED17-09 and SED17-13.

Sample ID	10-d *N. arenaceodentata* survival (%) (Mean ± SD)	10-d *E. estuarius* survival (Mean ± SD)	*S. purpuratus* Combined Proportion Normal (%) (Mean ± SD)
Control Seawater	96.0 ± 8.9	97.0 ± 4.5	71.6 ± 3.7
SED17-09	92.0 ± 11.0	35.0 ± 7.9	2.6 ± 3.2
SED17-13	100.0 ± 0.0	40.0 ± 12.8	0.1 ± 0.2

SD = Standard Deviation

TIE procedures involve physico-chemical manipulations of the sample, followed by toxicity tests on the treated and untreated samples, to provide information on the type of contaminant responsible for toxicity. Each of the treatments alters the toxicity of a subset of contaminants; thus, a change in toxicity as a result of the treatment provides an indication of the identity of the toxicant. General procedures are provided in USEPA guidance documents (USEPA 1991, and 1992a and b).

Constituents of concern, per communication with Golder Associates, were specified as divalent trace metals, PAHs and ammonia. Therefore, treatments targeting these constituents were incorporated into the evaluation to obtain information on their role in toxicity. This report presents the TIE treatments of the porewaters, the toxicity test methods and results, and an interpretation of the test results.

2.0 METHODS

The initial TIE testing on the undiluted SED17-09 and SED17-13 porewaters and TIE treatments of these porewaters were performed concurrent with the whole sediment testing on May 26, 2017 (Round 1). Porewaters were generated again for the SED17-09 and SED17-13 samples for a follow-up round of TIE testing on July 7, 2017 (Round 2). An additional porewater sample, SED17-22, was added to this round.

2.1 Porewater generation

The whole sediment samples were each transported in two 4-L plastic containers and received at temperatures ranging from 4.0 to 8.5° C. The samples were stored in the dark at 4 ± 2° C prior to and after testing was performed. Nitrogen gas was used to fill the headspace of containers after sediment/porewater was removed.

Upon opening of the 4-L plastic container, porewater extracted from sediment was centrifuged at 2500 rpm for 20 minutes, followed by the supernatant being decanted and collected for testing. Porewater was generated the day before testing, water quality (pH, salinity and DO) measured to ensure that the sample was appropriate for the test method and then stored at 4 ± 2°C overnight for TIE treatments and toxicity testing the following day. The first 4-L container (1of2) was used in Round 1 testing while a new container (2of2) was opened for Round 2 testing.

2.2 Testing methods

Methods for the toxicity tests are summarized in Table 2. The original whole sediment testing with *S. purpuratus* was conducted according to procedures described by the Puget Sound Estuary Program (PSEP, 1995). TIE porewater tests were performed in a similar manner, except that no sediment was added to the test solutions (U.S. EPA 1995, Section 15). In addition, the porewater test was extended from 72 hours (US EPA, 1995) to 96 hours to match the test duration of the whole sediment test (PSEP, 1995). Water quality was performed only at test initiation, and not at termination, due to limited porewater volume. In addition, due to the limited volume, test replication was reduced from four to three.

Statistical analyses for the tests were performed using CETIS (Tidepool Scientific Software, 2013). Combined proportion normal (%) was the most sensitive endpoint for the baseline tests and, therefore, was used for comparison in TIE treatments of the porewater test. Test datasheets and statistical printouts can be found in Appendix A.

2.3 TIE procedures

The following TIE treatments were performed on the undiluted porewater samples the day of testing in both Round 1 and 2.

EDTA chelation: EDTA is a chelating agent that binds to metal cations, such as copper, cadmium and zinc, and reduces their bioavailability. Thus, a reduction in toxicity following treatment with EDTA indicates that a metal that can be chelated with EDTA contributed to toxicity. The porewater samples were treated with two concentrations of EDTA (i.e., 20 mg/L and 100 mg/L) during Round 1, and with 100 mg/L only during Round 2. The porewater samples were allowed to equilibrate for 2 hours after EDTA addition and any alteration in sample pH was re-adjusted with 1M NaOH. EDTA control(s) were prepared by adding EDTA, at the same concentration(s), to natural seawater.

C18 filtration: This treatment is used to remove non-polar organic toxicants from the sample by sorption to the column substrate. The sample was pumped through a 6 mL J.T. Baker C18 SPE column (Sigma-Aldrich, Oakville, ON) at 10 mL/min. Removal of toxicity by C18 filtration would indicate organic toxicants were likely present in the sample. A C18 control was prepared by filtering natural seawater through a C18 column in the same manner as the samples.

2.4 Ammonia and copper tests

S. purpuratus survival and development was tested in natural seawater solutions spiked with ammonium chloride, added using an analytically-confirmed stock solution (1,000 mg/L as N) to produce nominal total ammonia concentrations of 0, 1.6, 3.1, 6.2, 12.5 and 25 mg/L (as N). Toxicity of ammonia is directly related to the unionized form of the compound and therefore conversions from total ammonia to unionized ammonia were performed. Copper chloride was added into natural seawater in a similar manner, using an analytically-confirmed stock solution (10 mg/L as Cu) to produce nominal concentrations of 0, 2.5, 5, 10, 20 and 40 µg/L (as Cu). The results from these spiked seawater solutions were used to compare against the concentrations in the porewater samples to determine the likelihood of effects from ammonia and copper on *S. purpuratus* survival and development in the porewaters, respectively.

2.5 Analytical chemistry

Ammonia analysis was performed on the porewaters using an in-house colorimetric method measured on a HACH spectrophotometer. Ammonia measurements were not initially conducted on the porewaters during Round 1 testing, but a subsample of porewater from the same 4-L container was used to determine an ammonia concentration two weeks after Round 1 testing. Ammonia was measured on the porewaters during Round 2 testing.

Porewaters in Round 2 were filtered through 0.45µm syringe-filters, preserved with nitric acid and sent to Brooks Applied Laboratories (Bothell, WA, USA) for analysis of dissolved Cu, Pb and Zn by ICP-QQQ-MS. Similarly, porewaters were filtered through 0.45µm syringe-filters and sent to Brooks Applied Labs for dissolved Hg by EPA Method 1631E. The Brooks Applied Labs report can be found in Appendix B.

Table 2. Summary of TIE test conditions: 96-h echinoderm *(S. purpuratus)* larval survival and development.

Test species	*Strongylocentrotus purpuratus*
Organism source	Nautilus Environmental, San Diego, CA
Organism age	<2-h post-fertilization
Test type	Static
Test duration	96 hours
Test vessel	30-mL glass vials
Test volume of overlying water	10 mL
Test replicates	3 per sample
Number of organisms	Approximately 200 embryos per replicate
Control/dilution water	Natural seawater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	Ambient laboratory lighting
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen, pH and salinity measured at test initiation
Test protocol	PSEP (1995)/ U.S. EPA (1995)
Statistical software	CETIS Version 1.8.7
Test endpoints	Survival, proportion normal, combined proportion normal
Test acceptability criteria for controls	≥70% combined proportion normal
Reference toxicant	Copper (added as $CuCl_2$)

3.0 RESULTS

Copies of laboratory data sheets and printouts of statistical analyses for the *S. purpuratus* test are provided in Appendix A. Analytical chemistry is provided in Appendix B and the chain-of-custody form is provided in Appendix C.

Results of the Round 1 TIE tests conducted on undiluted SED17-09 and SED17-13 porewater, concurrently with whole sediment tests on May 26, 2017, are displayed in Table 3. Adverse effects on development and survival of the echinoderms in the undiluted and untreated porewaters were observed. The combined proportion normal (i.e., fraction of larvae which survived and developed normally) was significantly lower in the for SED17-09 and SED17-13 porewaters than observed in natural seawater. This was similar to the effect observed on echinoderm development in the whole sediment sample tests (Table 1). Treatments of the samples targeting metals (EDTA addition) and organics (C18 filtration) did not improve the performance of *S. purpuratus*.

Table 3. *S. purpuratus* larval development: combined proportion normal in SED17-09 and SED17-13 undiluted porewater and TIE treatments (Round 1: May 26, 2017).

Sample ID	Combined Proportion Normal (%) Mean ± SD			
	Untreated	C18 Treated	EDTA Treated	
			20 mg/L	100 mg/L
Control [Natural Seawater]	71.9 ± 5.3	71.4 ± 4.2	70.1 ± 4.9	70.7 ± 2.1
SED17-09	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
SED17-13	3.0 ± 1.8	3.6 ± 0.8	4.5 ± 2.4	6.2 ± 1.9

Follow-up testing (Round 2) with the SED17-09 and SED17-13 porewaters demonstrated that the toxicity was limited to the full-strength and 50% dilution of the SED17-09 sample and the full-strength of the SED17-13 sample, respectively. This resulted in EC50s for combined proportion normal of 42.1 and 75.7 % (v/v) for SED17-09 and SED17-13, respectively.

Similar to Round 1, no improvement from the metal and organic-targeted TIE treatments employed (Table 4) was observed. Effect concentrations determined in these treated samples were not significantly higher than the untreated samples, demonstrating no removal of toxicity.

An additional porewater sample, SED17-22, tested during Round 2 exhibited more toxicity than the SED17-09 and SED1713 porewaters; an EC50 of 15.9 % v/v was determined for this porewater.

Testing of ammonia and copper-spiked seawater during Round 2 determined median effect concentrations (EC50) of 0.080 mg/L unionized ammonia and 27.4 μg/L Cu, respectively. The copper EC50 was within the historical range EC50s determined in copper toxicant tests completed in-house using this test method and the ammonia EC50 was similar to that observed elsewhere (Greenstein *et al.*, 1996).

Concentrations of dissolved trace metals from Round 2 porewater subsamples were determined to be very low (*i.e.*, below or close to analytical detection limits) (Table 6). Little difference was observed in the dissolved metal concentrations between untreated and treated samples of SED17-09, although the majority of concentrations were below their respective detection limits making comparisons immaterial. Total ammonia concentrations determined were higher in Round 2 than Round 1 (Table 7), potentially indicating generation of ammonia during sample storage.

Table 4. ***S. purpuratus*** **larval development: combined proportion normal in SED17-09, SED17-13 and SED17-22 porewater and TIE treatment dilution series (Round 2: July 7, 2017).**

Concentration (% v/v)	**Combined Proportion Normal (%) (Mean ± SD)**								
	SED17-09			SED17-13			SED17-22		
	Untreated	C18	EDTA	Untreated	C18	EDTA	Untreated	C18	EDTA
Control [Natural Seawater]	87.8 ± 7.9	85.4± 11.2	82.1 ± 6.9	81.6 ± 2.6	85.4 ± 11.2	82.1 ± 6.9	80.4 ± 3.8	85.4 ± 11.2	82.0 ± 6.9
6.2	77.4 ± 4.0	85.8 ± 1.5	78.0 ± 5.2	81.8 ± 5.4	82.4 ± 6.8	74.8 ± 4.8	85.5 ± 8.2	85.5 ± 6.0	81.8 ± 2.3
12.5	83.3 ± 8.2	83.9 ± 3.5	86.1 ± 2.1	83.6 ± 2.1	86.7 ± 3.8	81.9 ± 7.5	63.2 ± 2.0	80.8 ± 4.3	76.6± 8.5
25	87.3 ± 9.8	88.7 ± 2.4	88.5 ± 5.1	81.8 ± 2.0	86.6 ± 8.2	87.5 ± 6.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
50	31.0 ± 3.4	5.0 ± 0.7	1.8 ± 1.2	91.9 ± 9.1	88.4 ± 7.9	82.1 ± 7.8	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
100	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	13.6 ± 4.0	32.4 ± 1.7	13.9 ± 4.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
EC50 (% v/v) [95% Confidence Limits]	42.1 (37.0 – 47.4)	36.2 (32.3 – 36.5)	35.7 (34.3 - 36.4)	75.7 (71.7 – 78.8)	87.3 (77.4 – 90.2)	75.8 (67.4 – 79.1)	15.9 (14.9 – 16.7)	17.4 (15.6 – 18.1)	17.3 (15.6 – 18.2)
EC50 (mg/L unionized ammonia)	0.034	0.029	0.029	0.034	0.039	0.034	0.067	0.074	0.073

[EDTA]: 100 mg/L
SD = Standard Deviation; EC: Effect Concentration

Table 5. Results: 96-h echinoderm (*S. purpuratus*) larval survival and development test with ammonia (July 7, 2017).

Concentration (Total ammonia, mg/L as N)	Combined Proportion Normal (%) (Mean ± SD)
Control [Natural Seawater]	73.3± 5.3
0.8	80.2± 5.5
1.6	74.7± 7.1
3.2	78.4± 6.5
6.5	66.4± 3.8
13	0.0 ± 0.0
26	0.0 ± 0.0
as mg/L total ammonia as N	
EC25 (95% Confidence Limits)	7.1 (6.4 - 7.7)
EC50 (95% Confidence Limits)	8.8 (8.1 – 9.2)
as mg/L unionized ammonia as N	
EC25 (95% Confidence Limits)	0.065 (0.058 – 0.070)
EC50 (95% Confidence Limits)	0.080 (0.074 – 0.084)

SD = Standard Deviation; EC: Effect Concentration

Table 6. Dissolved trace metal concentrations of porewaters and treatments.

Analyte	SED17-09			SED17-13	SED17-22	*S. purpuratus* Thresholds [EC50, µg/L]
	Untreated	C18	EDTA			
Cu (µg/L)	0.229	<0.2	0.374	0.516	0.608	28 [1]
Hg (ng/L)	<0.51	<0.51	<0.51	1.10	0.62	N/A
Pb (µg/L)	<0.125	<0.125	<0.125	<0.125	<0.125	74 [2]
Zn (µg/L)	<1.5	<1.5	2.35	<1.5	<1.5	151 [2]

[1]: In-house testing concurrent with porewater testing
[2]: Nadella et al. 2013
SD = Standard Deviation; EC: Effect Concentration

Table 7. Total and unionized ammonia concentrations (as N)

Date Measured	Porewater ID	Temperature (°C)	pH	Salinity (ppt)	Total Ammonia (mg/L)	pKa	Unionized Ammonia (mg/L)
23-Jun-17	SED17-09	15	7.4	29	0.60 [1]	9.74	0.003 [1]
	SED17-13	15	7.7	29	5.50 [1]	9.74	0.050 [1]
7-Jul-17	SED17-09	15	7.6	29	11.0	9.74	0.080
	SED17-13	15	7.7	29	5.00	9.74	0.045
	SED17-22	15	7.8	29	37.0	9.74	0.423
7-Jul-17	25 mg/L ammonia solution	15	7.7	29	26.0	9.74	0.237

[1]: Concentrations determined from analysis of porewaters remaining in sample containers following May 26 testing.

4.0 DISCUSSION

The lack of improvement observed in the EDTA-addition and C18-filtration treatments indicates a toxicant other than a divalent metal or organic compound caused effects to *S. purpuratus* development in SED17-09 and SED17-13. In both rounds of TIE testing, the magnitude of adverse effects was similar between untreated and metal/organic treated samples, demonstrating the inability of the targeted treatments to remove the component causing adverse effects.

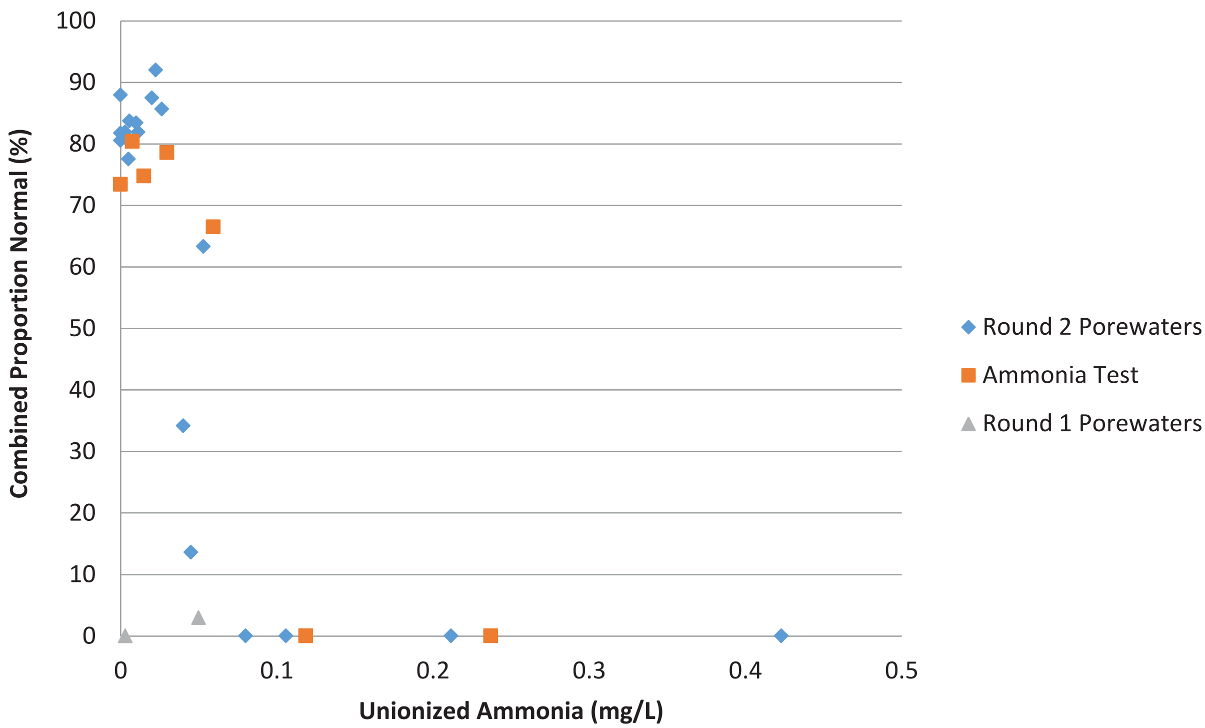
Concentrations of Pb, Cu and Zn were well below toxic thresholds for *S. purpuratus* (Table 5) providing further evidence that these trace metals were not contributing to toxicity. While no threshold for mercury was available for *S. purpuratus*, sensitivity of another purple sea urchin, *P. lividus,* to mercury was determined to be an order of magnitude higher than mercury concentrations observed in these porewaters (Fernandez and Beiras, 2001).

The testing with ammonia-spiked seawater determined significant effects on *S. purpuratus* development above unionized ammonia concentrations of 0.06 mg/L (as N). Calculating the EC50s of the SED17-09 and SED17-13 Round 2 porewater samples based on their unionized ammonia concentrations determined similar effect concentrations (Table 4) which were within a factor of two of the effect concentrations determined in the ammonia-only test. The agreement between ammonia endpoints in seawater-only and porewater samples suggests that ammonia could account for the toxicity observed in Round 2 TIE testing. In corroboration with this, an additional sediment porewater tested, SED17-22, was significantly more toxic than the porewaters of interest, SED17-09 and SED17-13, and contained a higher ammonia concentration. The impaired development observed in SED17-22 based on unionized ammonia, 0.067 mg/L, was also in general agreement with those expected based on the confidence interval for the threshold for unionized ammonia in seawater (i.e., 0.058 – 0.070 mg N/L).

Round 2 porewater samples exhibited a dose-response with unionized ammonia, with effects occurring approximate to and increasing above the ammonia threshold determined in the seawater spiked ammonia test (Figure 1). Meanwhile, ammonia concentrations determined in the Round 1 porewaters (May 26, 2017) were not above ammonia thresholds and appeared to deviate from the unionized ammonia dose response (Figure 1). Nevertheless, treatments for divalent metal and organic compounds were not effective during Round 1 porewater testing, pointing to ammonia as a more likely toxicant.

The lines of evidence presented support ammonia as the most likely cause of toxicity observed in the porewater TIE testing of SED17-09 and SED17-13, particularly in Round 2. The overall dose-response curve shown in Figure 1 appears to fit all tested samples, with the exception of the lower concentration of ammonia determined for SED17-09 in the Round 1 porewater testing. In addition, a lower concentration of ammonia was observed in the whole sediment tests (Nautilus Environmental, 2017), which makes it problematic to definitively identify ammonia as the cause of reduced performance of *S. purpuratus* in the whole sediment test. Interestingly, SED17-09 and SED17-13 samples both exhibited reduced survival of *E. estaurius* in whole sediment testing, despite *E. estaurius'* reduced sensitivity to ammonia in comparison to *S. purpuratus* (Bailey *et al.*, 1997).

Figure 1. Combined proportion normal development of *S. purpuratus* vs unionized ammonia concentrations in different concentrations of Round 1 and 2 porewaters, as well as the ammonia-spiked seawater.



5.0 QA/QC

The health history of the test organisms used in both rounds of testing were acceptable and met requirements of the protocols. The tests met all control acceptability criteria, and water quality parameters remained within ranges specified in the protocol at initiation of the test. Note that water quality was not measured throughout testing as is required by the protocol due to the limited porewater volume available to run an additional water quality test replicate.

Although proportion normal echinoderm larval counts were not presented in the results of this report, all controls resulted in > 80% proportion normal and the percent minimum significant difference relative to the controls was less than 20% as is required by the US EPA (1995) protocol.

Results of the reference toxicant tests conducted during the testing program are summarized in Table 8. Results for these tests fell within the range for organism performance of mean +/- two standard deviations, based on historical results obtained by the laboratory with this test. Thus, the sensitivity of the organisms used in these tests were appropriate. The reference toxicant test was performed under the same conditions as those used for the sample.

Table 8. Reference toxicant test results.

Test Species	Endpoint	Historical Mean (2 SD Range)	CV (%)	Test Date
S. purpuratus	Proportion normal (EC50): 17.8 µg/L Cu	21.8 (14.7 – 32.3) µg/L Cu	22	May 26, 2017
	Proportion normal (EC50): 27.4 µg/L Cu			July 7, 2017

EC = Effect Concentration, SD = Standard Deviation, CV = Coefficient of Variation

6.0 REFERENCES

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APPENDIX A – *Strongylocentrotus purpuratus* Toxicity Test Data

Echinoderm Larvae Development Toxicity Test Data Sheet
Larval Counts - porewater

Client: Golder
Work Order #: 170469-TIE
Sample ID: SED17-09

Start Date/Time: July 7/17@1600h
Test species: S. purpuratus
Test set up by: JAB
Initial Density/ 10mL: 221

Concentration	Rep	No. Normal	No. Abnormal	Comments	Initials
6.2	A	164	5		JAB
	B	168	4		
	C	181	6		
	D				
12.5	A	203	2		
	B	167	1		
	C	182	5		
	D				
25	A	196	3		
	B	213	4		
	C	170	5		
	D				
50	A	JAB ~~81~~ 61	JAB ~~44~~ 91		
	B	76	126		
	C	69	109		
	D				
100	A	0	112		
	B	0	171		
	C	0	167		
	D				
	A				
	B				
	C				
	D				
Control	A	195	2		JAB
	B	JAB ~~195~~ 211	JAB ~~2~~ 7		
	C	~~211~~ 176	~~7~~ 3		
	D				

Comments:

Reviewed by: JGh Date Reviewed: Sep-11/17

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	02-4100-6171	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	30 Aug-17 12:56	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Batch ID:	01-9840-0287	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	07 Jul-17 16:00	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Natural seawater
Ending Date:	11 Jul-17 16:00	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	96h	**Source:**	San Diego Lab	**Age:**	

Sample ID:	09-1217-9424	**Code:**	365EC0E0	**Client:**	Golder Associates
Sample Date:	29 Apr-17 17:00	**Material:**	Porewater	**Project:**	
Receive Date:	15 May-17	**Source:**	Golder		
Sample Age:	68d 23h	**Station:**	SED17-09		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1153096	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	4.417	N/A	50.75	22.64	1.97	NA
EC10	26.27	N/A	30	3.807	3.334	NA
EC15	27.88	21.97	31.7	3.587	3.154	4.552
EC20	29.58	23.78	33.5	3.38	2.985	4.206
EC25	31.39	25.64	35.4	3.186	2.825	3.9
EC40	37.46	32.2	42.17	2.669	2.372	3.106
EC50	42.14	37.01	47.44	2.373	2.108	2.702

Combined Proportion Normal Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Negative Control	3	0.8778	0.7964	0.9548	0.04577	0.07928	9.03%	0.0%	582	663
6.2		3	0.7738	0.7421	0.819	0.02322	0.04022	5.2%	11.86%	513	663
12.5		3	0.8326	0.7557	0.9186	0.04724	0.08182	9.83%	5.16%	552	663
25		3	0.8733	0.7692	0.9638	0.05658	0.09799	11.22%	0.52%	579	663
50		3	0.3107	0.276	0.3439	0.01961	0.03396	10.93%	64.6%	206	663
100		3	0	0	0	0	0		100.0%	0	663

Combined Proportion Normal Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	0.8824	0.9548	0.7964
6.2		0.7421	0.7602	0.819
12.5		0.9186	0.7557	0.8235
25		0.8869	0.9638	0.7692
50		0.276	0.3439	0.3122
100		0	0	0

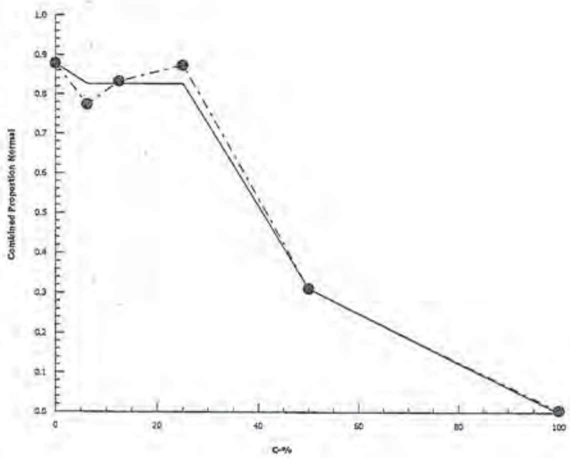
Combined Proportion Normal Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	195/221	211/221	176/221
6.2		164/221	168/221	181/221
12.5		203/221	167/221	182/221
25		196/221	213/221	170/221
50		61/221	76/221	69/221
100		0/221	0/221	0/221

Echinoid Embryo-Larval Survival and Development Test | **Nautilus Environmental**

Analysis ID:	02-4100-6171	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	30 Aug-17 12:56	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Analyst: JAB QA: JGL Sep. 11/17

Echinoderm Larvae Development Toxicity Test Data Sheet
Larval Counts

Client: Golder
Work Order #: 170469- TIE
Sample ID: SED17-09 C18

Start Date/Time: July 7/17 @ 1600h
Test species: S. purpuratus
Test set up by: JAB
Initial Density/ 10mL: 221

Concentration	Rep	No. Normal	No. Abnormal	Comments	Initials
6.2	A	186	3		YM
	B	192	6		
	C	191	8		
	D				
12.5	A	194	6		
	B	179	3		
	C	183	2		
	D				
25	A	200	5		
	B	198	3		
	C	190	4		
	D				
50	A	13	189		
	B	12	184		
	C	8	180		
	D				
100	A	0	94		
	B	0	104		
	C	0	107		
	D				
	A				
	B				
	C				
	D				
Control	A	217	2		JAB
	B	172	5		
	C	177	6		
	D				

Comments:

Reviewed by: JGh   Date Reviewed: Sep. 11/17

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	12-9104-9952	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	28 Aug-17 11:26	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	18-7959-8686	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	07 Jul-17 16:00	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Natural seawater
Ending Date:	11 Jul-17 16:00	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	96h	**Source:**	San Diego Lab	**Age:**	
Sample ID:	16-4847-7160	**Code:**	6241C3E8	**Client:**	Golder Associates
Sample Date:	29 Apr-17 17:00	**Material:**	Porewater	**Project:**	
Receive Date:	15 May-17	**Source:**	Golder		
Sample Age:	68d 23h	**Station:**	SED17-09 C18		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1646390	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	25.95	N/A	25.97	3.854	3.851	NA
EC10	26.93	N/A	26.97	3.714	3.708	NA
EC15	27.94	22.91	28.01	3.579	3.57	4.364
EC20	29	24.08	29.09	3.449	3.437	4.153
EC25	30.09	25.3	30.21	3.323	3.31	3.953
EC40	33.61	29.31	33.83	2.975	2.956	3.412
EC50	36.18	32.31	36.47	2.764	2.742	3.095

Combined Proportion Normal Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Negative Control	3	0.8537	0.7783	0.9819	0.06443	0.1116	13.07%	0.0%	566	663
6.2		3	0.8582	0.8416	0.8688	0.008398	0.01455	1.7%	-0.53%	569	663
12.5		3	0.8386	0.81	0.8778	0.02029	0.03515	4.19%	1.77%	556	663
25		3	0.8869	0.8597	0.905	0.01382	0.02394	2.7%	-3.89%	588	663
50		3	0.04977	0.0362	0.05882	0.006912	0.01197	24.05%	94.17%	33	663
100		3	0	0	0	0	0		100.0%	0	663

Combined Proportion Normal Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	0.9819	0.7783	0.8009
6.2		0.8416	0.8688	0.8643
12.5		0.8778	0.81	0.8281
25		0.905	0.8959	0.8597
50		0.05882	0.0543	0.0362
100		0	0	0

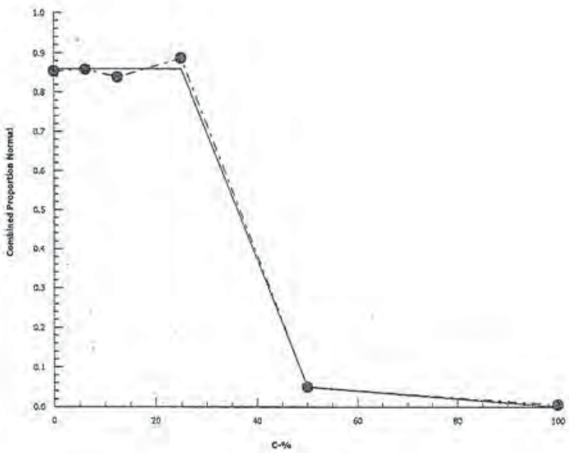
Combined Proportion Normal Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	217/221	172/221	177/221
6.2		186/221	192/221	191/221
12.5		194/221	179/221	183/221
25		200/221	198/221	190/221
50		13/221	12/221	8/221
100		0/221	0/221	0/221

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	12-9104-9952	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	28 Aug-17 11:26	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Echinoderm Larvae Development Toxicity Test Data Sheet
Larval Counts

Client: Golder
Work Order #: 170469-TIE
Sample ID: SED17-09 EDTA
Start Date/Time: July 7/17 @ 1600 h
Test species: S. purpuratus
Test set up by: JAB
Initial Density/ 10mL: 221

Concentration	Rep	No. Normal	No. Abnormal	Comments	Initials
6.2	A	180	2		YW
	B	178	4		
	C	159	4		
	D				
12.5	A	185	6		
	B	193	3		
	C	193	4		
	D				
25	A	183	10		
	B	205	6		
	C	199	3		
	D				
50	A	3	183		
	B	9	195		
	C	0	198		
	D				
100	A	0	142		
	B	0	159		
	C	0	146		
	D				
	A				
	B				
	C				
	D				
Control	A	165	3		JAB
	B	184	4		
	C	195	6		
	D				

Comments:

Reviewed by: JG Date Reviewed: Sep. 11/17

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	00-9498-9150	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	28 Aug-17 11:24	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Batch ID:	14-6162-2264	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	07 Jul-17 16:00	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Natural seawater
Ending Date:	11 Jul-17 16:00	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	96h	**Source:**	San Diego Lab	**Age:**	

Sample ID:	12-8864-0841	**Code:**	4CCF1949	**Client:**	Golder Associates
Sample Date:	29 Apr-17 17:00	**Material:**	Porewater	**Project:**	
Receive Date:	15 May-17	**Source:**	Golder		
Sample Age:	68d 23h	**Station:**	SED17-09 EDTA		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1751169	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	25.91	24.11	25.97	3.859	3.851	4.148
EC10	26.85	25.09	26.97	3.724	3.708	3.985
EC15	27.83	26.12	28.01	3.593	3.571	3.829
EC20	28.84	27.18	29.08	3.468	3.438	3.679
EC25	29.88	28.26	30.2	3.346	3.311	3.538
EC40	33.25	31.79	33.8	3.008	2.958	3.146
EC50	35.69	34.31	36.44	2.802	2.744	2.915

Combined Proportion Normal Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Negative Control	3	0.8205	0.7466	0.8824	0.03965	0.06867	8.37%	0.0%	544	663
6.2		3	0.7798	0.7195	0.8145	0.03028	0.05244	6.73%	4.96%	517	663
12.5		3	0.8612	0.8371	0.8733	0.01207	0.0209	2.43%	-4.96%	571	663
25		3	0.8854	0.8281	0.9276	0.02971	0.05146	5.81%	-7.9%	587	663
50		3	0.0181	0	0.04072	0.01197	0.02074	114.6%	97.79%	12	663
100		3	0	0	0	0	0		100.0%	0	663

Combined Proportion Normal Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	0.7466	0.8326	0.8824
6.2		0.8145	0.8054	0.7195
12.5		0.8371	0.8733	0.8733
25		0.8281	0.9276	0.9005
50		0.01357	0.04072	0
100		0	0	0

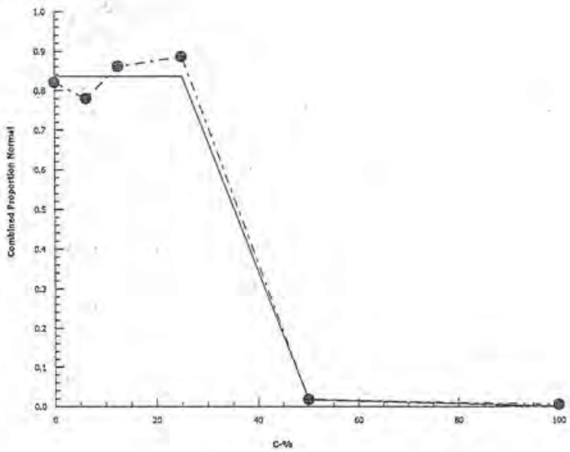
Combined Proportion Normal Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	165/221	184/221	195/221
6.2		180/221	178/221	159/221
12.5		185/221	193/221	193/221
25		183/221	205/221	199/221
50		3/221	9/221	0/221
100		0/221	0/221	0/221

Echinoid Embryo-Larval Survival and Development Test | **Nautilus Environmental**

Analysis ID:	00-9498-9150	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	28 Aug-17 11:24	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Echinoderm Larvae Development Toxicity Test Data Sheet
Larval Counts

Client: Golder
Work Order #: 170469-TIE
Sample ID: SED17-13

Start Date/Time: July 7/17 @ 1600h
Test species: S. purpuratus
Test set up by: JAB
Initial Density/ 10mL: 221

Concentration	Rep	No. Normal	No. Abnormal	Comments	Initials
Control	A	178	4		JAB
	B	176	1		↓
	C	187	3		
	D				
6.2	A	180	1		JAB
	B	193	3		
	C	169	2		
	D				
12.5	A	183	0		
	B	181	5		
	C	190	7		
	D				
25	A	176	1		
	B	185	1		
	C	181	5		
	D				
50	A	218	1		
	B	180	0		
	C	211	5		
	D				
100	A	37	173		
	B	33	181		
	C	20	149		
	D				↓
	A				
	B				
	C				
	D				

Comments:

Reviewed by: JGL

Date Reviewed: Sep. 11/17

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	12-5584-1574	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	30 Aug-17 12:20	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	03-4438-4222	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	07 Jul-17 16:00	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Natural seawater
Ending Date:	11 Jul-17 16:00	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	96h	**Source:**	San Diego Lab	**Age:**	
Sample ID:	17-1142-9369	**Code:**	660256F9	**Client:**	Golder Associates
Sample Date:	29 Apr-17 17:00	**Material:**	Porewater	**Project:**	
Receive Date:	15 May-17	**Source:**	Golder		
Sample Age:	68d 23h	**Station:**	SED17-13		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	732224	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	52.12	50.17	52.33	1.919	1.911	1.993
EC10	54.33	52.63	54.77	1.841	1.826	1.9
EC15	56.63	55.14	57.33	1.766	1.744	1.813
EC20	59.03	57.56	59.99	1.694	1.667	1.737
EC25	61.52	59.84	62.78	1.625	1.593	1.671
EC40	69.65	66.69	71.94	1.436	1.39	1.499
EC50	75.65	71.66	78.76	1.322	1.27	1.395

Combined Proportion Normal Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Negative Control	3	0.816	0.7964	0.8462	0.01531	0.02651	3.25%	0.0%	541	663
6.2		3	0.8175	0.7647	0.8733	0.03139	0.05436	6.65%	-0.18%	542	663
12.5		3	0.8356	0.819	0.8597	0.01235	0.02138	2.56%	-2.4%	554	663
25		3	0.8175	0.7964	0.8371	0.01178	0.0204	2.5%	-0.18%	542	663
50		3	0.9186	0.8145	0.9864	0.05283	0.09151	9.96%	-12.57%	609	663
100		3	0.1357	0.0905	0.1674	0.02322	0.04022	29.63%	83.36%	90	663

Combined Proportion Normal Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	0.8054	0.7964	0.8462
6.2		0.8145	0.8733	0.7647
12.5		0.8281	0.819	0.8597
25		0.7964	0.8371	0.819
50		0.9864	0.8145	0.9548
100		0.1674	0.1493	0.0905

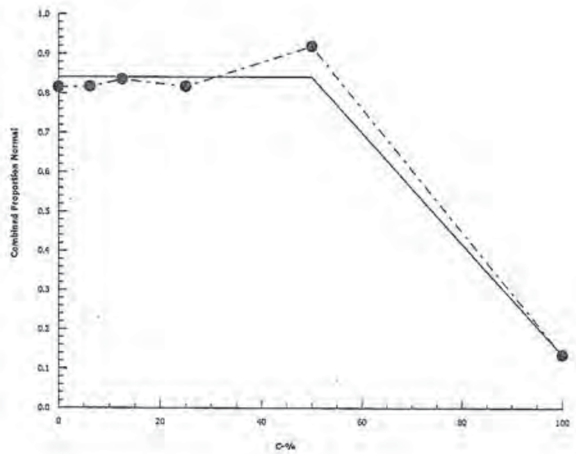
Combined Proportion Normal Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	178/221	176/221	187/221
6.2		180/221	193/221	169/221
12.5		183/221	181/221	190/221
25		176/221	185/221	181/221
50		218/221	180/221	211/221
100		37/221	33/221	20/221

Echinoid Embryo-Larval Survival and Development Test | **Nautilus Environmental**

Analysis ID:	12-5584-1574	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	30 Aug-17 12:20	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Analyst: JAB QA: JBL Sep 14/17

Echinoderm Larvae Development Toxicity Test Data Sheet
Larval Counts

Client: Golder
Work Order #: 170469-TIE
Sample ID: SED17-13 C18

Start Date/Time: July 7/17 @ 1600h
Test species: S. purpuratus
Test set up by: JAB
Initial Density/ 10mL: 221

Concentration	Rep	No. Normal	No. Abnormal	Comments	Initials
6.2	A	166	3		JAB
	B	196	5		
	C	184	1		
	D				
12.5	A	183	1		
	B	192	3		
	C	200	2		
	D				
25	A	178	6		
	B	212	6		
	C	184	5		
	D				
50	A	195	2		
	B	213	2		
	C	178	9		
	D				
100	A	69	148		
	B	76	132		
	C	70	139		↓
	D				
	A				
	B				
	C				
	D				
Control (C18)	A	217	2		JAB
	B	172	5		
	C	177	6		↓
	D				

Comments:

Reviewed by: JG   Date Reviewed: Sep. 11/17

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	02-9387-1800	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	28 Aug-17 11:30	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Batch ID:	11-9935-0211	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	07 Jul-17 16:00	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Natural seawater
Ending Date:	11 Jul-17 16:00	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	96h	**Source:**	San Diego Lab	**Age:**	

Sample ID:	04-9151-1923	**Code:**	1D4BE073	**Client:**	Golder Associates
Sample Date:	29 Apr-17 15:00	**Material:**	Porewater	**Project:**	
Receive Date:	15 May-17	**Source:**	Golder		
Sample Age:	69d 1h	**Station:**	SED17-13 C18		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1572337	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	52.88	N/A	53.05	1.891	1.885	NA
EC10	55.92	43.74	56.28	1.788	1.777	2.286
EC15	59.13	47.14	59.71	1.691	1.675	2.121
EC20	62.52	50.43	63.34	1.599	1.579	1.983
EC25	66.11	53.95	67.19	1.513	1.488	1.854
EC40	78.12	67.33	80.17	1.28	1.247	1.485
EC50	87.3	77.43	90.16	1.145	1.109	1.291

Combined Proportion Normal Summary

			Calculated Variate(A/B)								
C-%	**Control Type**	**Count**	**Mean**	**Min**	**Max**	**Std Err**	**Std Dev**	**CV%**	**%Effect**	**A**	**B**
0	Negative Control	3	0.8537	0.7783	0.9819	0.06443	0.1116	13.07%	0.0%	566	663
6.2		3	0.8235	0.7511	0.8869	0.03945	0.06832	8.3%	3.53%	546	663
12.5		3	0.8673	0.8281	0.905	0.02222	0.03848	4.44%	-1.59%	575	663
25		3	0.8658	0.8054	0.9593	0.04741	0.08212	9.49%	-1.41%	574	663
50		3	0.8839	0.8054	0.9638	0.04572	0.0792	8.96%	-3.53%	586	663
100		3	0.3243	0.3122	0.3439	0.009891	0.01713	5.28%	62.01%	215	663

Combined Proportion Normal Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	0.9819	0.7783	0.8009
6.2		0.7511	0.8869	0.8326
12.5		0.8281	0.8688	0.905
25		0.8054	0.9593	0.8326
50		0.8824	0.9638	0.8054
100		0.3122	0.3439	0.3167

Combined Proportion Normal Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	217/221	172/221	177/221
6.2		166/221	196/221	184/221
12.5		183/221	192/221	200/221
25		178/221	212/221	184/221
50		195/221	213/221	178/221
100		69/221	76/221	70/221

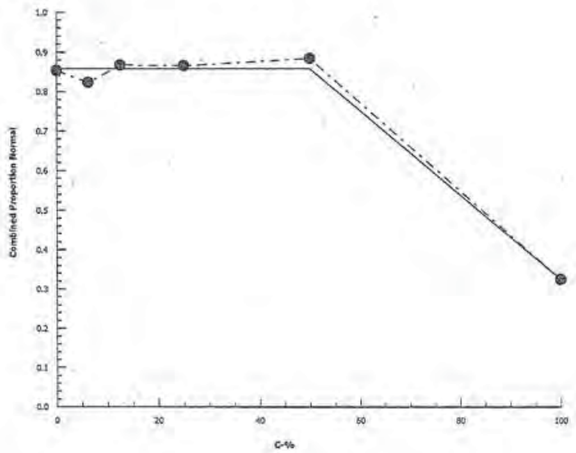
CETIS Analytical Report

Report Date:	28 Aug-17 11:32 (p 2 of 2)
Test Code:	GAPWTIE-5 | 03-0120-8937

Echinoid Embryo-Larval Survival and Development Test **Nautilus Environmental**

Analysis ID:	02-9387-1800	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	28 Aug-17 11:30	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Echinoderm Larvae Development Toxicity Test Data Sheet
Larval Counts

Client: Golder
Work Order #: 170469 - TIE
Sample ID: SED17-13 EDTA
Start Date/Time: July 7/17 @ 1600 h
Test species: S. purpuratus
Test set up by: JAB
Initial Density/ 10mL: 221

Concentration	Rep	No. Normal	No. Abnormal	Comments	Initials
6.2	A	~~154~~ JAB	~~10~~ JAB		
	B	167	6		JAB
	C	175	5		JAB
	D	154	10		JAB
12.5	A				
	B	180	4		JAB
	C	198	7		JAB
	D	165	5		JAB
25	A				
	B	188	7		JAB
	C	210	3		JAB
	D	182	8		JAB
50	A				
	B	195	6		JAB
	C	187	5		JAB
	D	162	7		JAB
100	A				
	B	22	164		JAB
	C	40	142		JAB
	D	30	141		JAB
	A				
	B				
	C				
	D				
Control (EDTA)	A	165	3		JAB
	B	184	4		JAB
	C	195	6		JAB
	D				

Comments:

Reviewed by: JGM Date Reviewed: Sep. 11/17

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	08-3614-5779	Endpoint:	Combined Proportion Normal	CETIS Version:	CETISv1.8.7
Analyzed:	28 Aug-17 11:31	Analysis:	Linear Interpolation (ICPIN)	Official Results:	Yes

Batch ID:	02-9632-9862	Test Type:	Development-Survival	Analyst:	
Start Date:	07 Jul-17 16:00	Protocol:	EPA/600/R-95/136 (1995)	Diluent:	Natural seawater
Ending Date:	11 Jul-17 16:00	Species:	Strongylocentrotus purpuratus	Brine:	
Duration:	96h	Source:	San Diego Lab	Age:	

Sample ID:	12-7550-0243	Code:	4C0696D3	Client:	Golder Associates
Sample Date:	29 Apr-17 15:00	Material:	Porewater	Project:	
Receive Date:	15 May-17	Source:	Golder		
Sample Age:	69d 1h	Station:	SED17-13 EDTA		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	895213	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	51.89	N/A	52.62	1.927	1.901	NA
EC10	54.13	31.31	55.06	1.847	1.816	3.194
EC15	56.46	46.55	57.62	1.771	1.736	2.148
EC20	58.89	48.92	60.29	1.698	1.659	2.044
EC25	61.42	51.51	63.08	1.628	1.585	1.941
EC40	69.68	60.69	72.25	1.435	1.384	1.648
EC50	75.79	67.4	79.08	1.319	1.265	1.484

Combined Proportion Normal Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Negative Control	3	0.8205	0.7466	0.8824	0.03965	0.06867	8.37%	0.0%	544	663
6.2		3	0.7481	0.6968	0.7919	0.02769	0.04796	6.41%	8.82%	496	663
12.5		3	0.819	0.7466	0.8959	0.04316	0.07476	9.13%	0.18%	543	663
25		3	0.8748	0.8235	0.9502	0.03851	0.06671	7.63%	-6.62%	580	663
50		3	0.8205	0.733	0.8824	0.04497	0.07789	9.49%	0.0%	544	663
100		3	0.1388	0.09955	0.181	0.02356	0.04081	29.41%	83.09%	92	663

Combined Proportion Normal Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	0.7466	0.8326	0.8824
6.2		0.7557	0.7919	0.6968
12.5		0.8145	0.8959	0.7466
25		0.8507	0.9502	0.8235
50		0.8824	0.8462	0.733
100		0.09955	0.181	0.1357

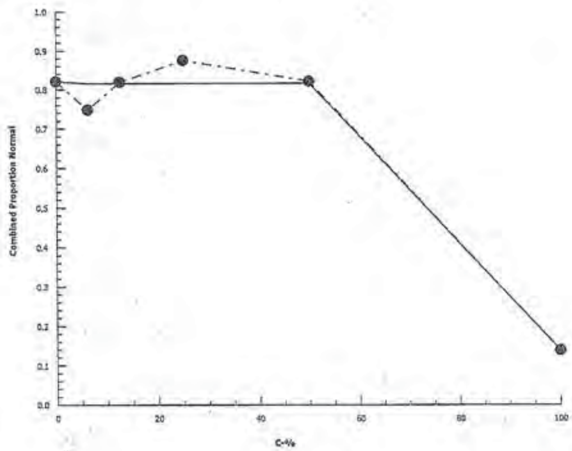
Combined Proportion Normal Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	165/221	184/221	195/221
6.2		167/221	175/221	154/221
12.5		180/221	198/221	165/221
25		188/221	210/221	182/221
50		195/221	187/221	162/221
100		22/221	40/221	30/221

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID: 08-3614-5779		**Endpoint:** Combined Proportion Normal		**CETIS Version:** CETISv1.8.7	
Analyzed: 28 Aug-17 11:31		**Analysis:** Linear Interpolation (ICPIN)		**Official Results:** Yes	

Graphics



Echinoderm Larvae Development Toxicity Test Data Sheet
Larval Counts

Client: Golder
Work Order #: 170469-TIE
Sample ID: SED17-22

Start Date/Time: ~~May 26/17 @~~ JAB July 7/17 @ 1600h
Test species: S. purpuratus
Test set up by: JAB
Initial Density/ 10mL: 221

Concentration (% v/v)	Rep	No. Normal	No. Abnormal	Comments	Initials
Control	A	171	4		YML
	B	175	6		
	C	187	4		
	D	—	—		
6.3	A	208	3		
	B	187	5		
	C	172	4		
	D	—	—		
12.5	A	135	55		
	B	144	32		
	C	140	65		
	D	—	—		
25	A	0	109		
	B	0	103		
	C	0	97		
	D	—	—		
50	A	0	87		
	B	0	72		
	C	0	64		
	D	—	—		
100	A	0	90		
	B	0	115		
	C	0	95		
	D	—	—		
	A				
	B				
	C				
	D				

Comments:

Reviewed by: JGL

Date Reviewed: Sep. 11/17

Echinoderm Development Toxicity Test Data Sheet

Client: Golder
Sample ID: SED17 Porewater TIE
Test No.: 170469-TIE

Start Date & Time: July 7/17 @ 1600h
End Date & Time: July 11/17 @ 1600h
Test species: S. purpuratus

Concentration / Treatment	Temperature (°C)					Dissolved oxygen (mg/L)					pH (units)					Salinity (ppt)				
	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
SW Control	15.0					8.0					~~7.5~~ 7.7					28				
C18 Control	15.0					7.9					7.8					28				
EDTA Control ①	15.0					7.9					7.6②					28				
SED17-09	15.0					7.2					7.6					~~30~~ 29				
-09 C18	15.0					7.4					7.6					~~30~~ 29				
-09 EDTA①	15.0					7.3					7.6②					~~30~~ 29				
SED17-13	15.0					7.2					7.7					30				
-13 C18	15.0					7.3					7.6					30				
-13 EDTA①	15.0					7.2					7.6					30				
SED17-22	15.0					7.4					7.8					30				
-22 C18	15.0					7.6					7.8					30				
-22 EDTA ①	15.0					7.4					7.8②					30				
											~~7.6~~ JAB									
Analyst Initials	JAB					JAB					JAB					JAB				

Initial Water Quality				
Conc.	Temp	DO	pH	Salinity
Control				
100% sample				

Sample Description: Porewaters

Test Set up by: JAB / YYL

Comments:
0 hrs: ① 100 mg/L EDTA ② Adjusted w/ 1M NaOH after EDTA
24 hrs.
48 hrs.

Reviewed by: JGh

Date Reviewed: Sep. 11/17

CETIS Analytical Report

Report Date: 01 Sep-17 10:28 (p 1 of 2)
Test Code: GAPWTIE-7 | 00-8231-9270

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	19-2295-7373	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	01 Sep-17 10:28	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	11-8007-2458	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	07 Jul-17 16:00	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Natural seawater
Ending Date:	11 Jul-17 16:00	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	96h	**Source:**	San Diego Lab	**Age:**	
Sample ID:	06-9083-5900	**Code:**	292D51BC	**Client:**	Golder Associates
Sample Date:	01 May-17 17:00	**Material:**	Porewater	**Project:**	
Receive Date:	15 May-17 10:30	**Source:**	Golder		
Sample Age:	66d 23h	**Station:**	SED17-22		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	62035	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	7.216	3.385	7.585	13.86	13.18	29.54
EC10	8.375	6.686	9.367	11.94	10.68	14.96
EC15	9.697	8.175	11.56	10.31	8.647	12.23
EC20	11.21	9.011	14.01	8.924	7.138	11.1
EC25	12.64	10.21	13.62	7.913	7.343	9.798
EC40	14.52	13.42	15.41	6.889	6.491	7.454
EC50	15.91	14.91	16.72	6.285	5.982	6.708

Combined Proportion Normal Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Negative Control	3	0.8039	0.7738	0.8462	0.02175	0.03768	4.69%	0.0%	533	663
6.2		3	0.8552	0.7783	0.9412	0.04724	0.08182	9.57%	-6.38%	567	663
12.5		3	0.632	0.6109	0.6516	0.01178	0.0204	3.23%	21.39%	419	663
25		3	0	0	0	0	0		100.0%	0	663
50		3	0	0	0	0	0		100.0%	0	663
100		3	0	0	0	0	0		100.0%	0	663

Combined Proportion Normal Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	0.7738	0.7919	0.8462
6.2		0.9412	0.8462	0.7783
12.5		0.6109	0.6516	0.6335
25		0	0	0
50		0	0	0
100		0	0	0

Combined Proportion Normal Binomials

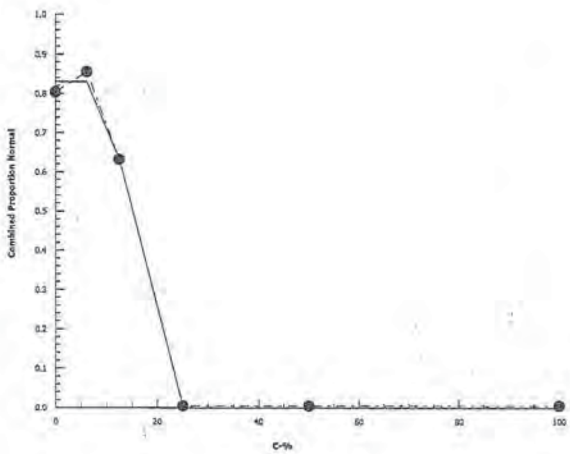
C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	171/221	175/221	187/221
6.2		208/221	187/221	172/221
12.5		135/221	144/221	140/221
25		0/221	0/221	0/221
50		0/221	0/221	0/221
100		0/221	0/221	0/221

Analyst: TAB QA: JGk Sep 11/17

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID: 19-2295-7373		**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed: 01 Sep-17 10:28		**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Echinoderm Larvae Development Toxicity Test Data Sheet
Larval Counts

Client: Golder
Work Order #: 170469 - TIE
Sample ID: SED17-22 C18

Start Date/Time: July 7/17 @1600h
Test species: S. purpuratus
Test set up by: JAB
Initial Density/ 10mL: 221

Concentration	Rep	No. Normal	No. Abnormal	Comments	Initials
~~Control~~ 6.3	A	204	4		YMC
	B	184	5		
	C	179	7		
	D				
12.5	A	170	18		
	B	177	14		
	C	189	21		
	D				
25	A	0	170		
	B	0	175		
	C	0	154		
	D				
50	A	0	134		
	B	0	150		
	C	0	105		
	D				
100	A	0	141		
	B	0	137		
	C	0	126		
	D				
	A				
	B				
	C				
	D				
Control (C18)	A	217	2		JAB
	B	172	5		
	C	177	6		
	D				

Comments:

Reviewed by: JGL Date Reviewed: Sep. 11/17

CETIS Analytical Report

Report Date: 01 Sep-17 10:36 (p 1 of 2)
Test Code: GAPWTIE-9 | 00-6906-4916

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	16-9232-7540	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	01 Sep-17 10:35	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Batch ID:	00-2824-7501	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	07 Jul-17 16:00	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Natural seawater
Ending Date:	11 Jul-17 16:00	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	96h	**Source:**	San Diego Lab	**Age:**	

Sample ID:	08-0477-7846	**Code:**	2FF7EF76	**Client:**	Golder Associates
Sample Date:	01 May-17 17:00	**Material:**	Porewater	**Project:**	
Receive Date:	15 May-17 10:30	**Source:**	Golder		
Sample Age:	66d 23h	**Station:**	SED17-22 C18		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1914546	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	11.91	N/A	14.1	8.398	7.095	NA
EC10	12.94	N/A	13.94	7.729	7.175	NA
EC15	13.43	8.7	14.41	7.446	6.942	11.49
EC20	13.94	11.7	14.89	7.174	6.717	8.546
EC25	14.46	12.29	15.39	6.913	6.499	8.138
EC40	16.16	14.21	16.97	6.189	5.892	7.036
EC50	17.39	15.64	18.12	5.751	5.52	6.392

Combined Proportion Normal Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Negative Control	3	0.8537	0.7783	0.9819	0.06443	0.1116	13.07%	0.0%	566	663
6.2		3	0.8552	0.81	0.9231	0.03456	0.05986	7.0%	-0.18%	567	663
12.5		3	0.8084	0.7692	0.8552	0.0251	0.04348	5.38%	5.3%	536	663
25		3	0	0	0	0	0		100.0%	0	663
50		3	0	0	0	0	0		100.0%	0	663
100		3	0	0	0	0	0		100.0%	0	663

Combined Proportion Normal Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	0.9819	0.7783	0.8009
6.2		0.9231	0.8326	0.81
12.5		0.7692	0.8009	0.8552
25		0	0	0
50		0	0	0
100		0	0	0

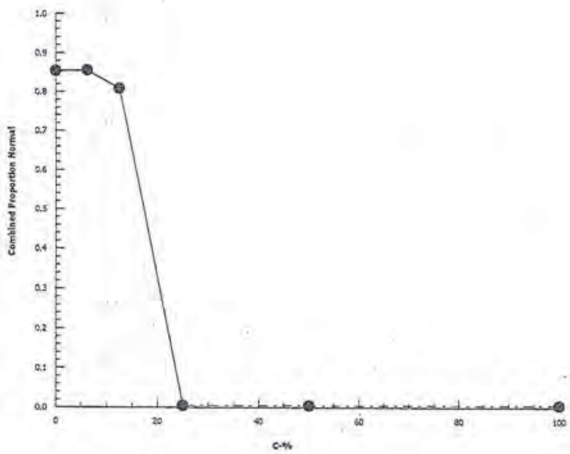
Combined Proportion Normal Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	217/221	172/221	177/221
6.2		204/221	184/221	179/221
12.5		170/221	177/221	189/221
25		0/221	0/221	0/221
50		0/221	0/221	0/221
100		0/221	0/221	0/221

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	16-9232-7540	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	01 Sep-17 10:35	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Echinoderm Larvae Development Toxicity Test Data Sheet
Larval Counts

Client: Golder
Work Order #: 170469 - TIE
Sample ID: SED17- 22 EDTA
Start Date/Time: July 7/17 @ 1600h
Test species: S. purpuratus
Test set up by: JAB
Initial Density/ 10mL: 221

Concentration	Rep	No. Normal	No. Abnormal	Comments	Initials
~~Control~~ 6.3	A	176	8		YM
	B	186	2		
	C	180	4		
	D	—	—		
12.5	A	191	34		
	B	158	32		
	C	159	28		
	D	—	—		
25	A	0	148		
	B	0	137		
	C	0	114		
	D	—	—		
50	A	0	81		
	B	0	60		
	C	0	69		
	D	—	—		
100	A	0	103		
	B	0	98		
	C	0	113		
	D	—	—		
	A				
	B				
	C				
	D				
Control (EDTA)	A	165	3		JAB
	B	184	4		
	C	195	6		
	D				

Comments:

Reviewed by: JGh
Date Reviewed: Sep. 11/17

CETIS Analytical Report

Report Date: 30 Aug-17 13:43 (p 1 of 2)
Test Code: GAPWTIE-8 | 19-5395-0338

Echinoid Embryo-Larval Survival and Development Test — **Nautilus Environmental**

Analysis ID:	05-1129-3496	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	30 Aug-17 13:43	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes
Batch ID:	06-7881-5727	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	07 Jul-17 16:00	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Natural seawater
Ending Date:	11 Jul-17 16:00	**Species:**	Strongylocentrotus purpuratus	**Brine:**	
Duration:	96h	**Source:**	San Diego Lab	**Age:**	
Sample ID:	17-7372-0021	**Code:**	69B8D1D5	**Client:**	Golder Associates
Sample Date:	01 May-17 17:00	**Material:**	Porewater	**Project:**	
Receive Date:	15 May-17 10:30	**Source:**	Golder		
Sample Age:	66d 23h	**Station:**	SED17-22 EDTA		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	289294	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	10.47	N/A	15.67	9.548	6.38	NA
EC10	12.82	2.644	14.06	7.798	7.111	37.82
EC15	13.32	8.378	14.53	7.509	6.883	11.94
EC20	13.83	11.7	15.01	7.231	6.663	8.546
EC25	14.36	12.29	15.5	6.964	6.451	8.138
EC40	16.06	14.21	17.08	6.225	5.856	7.037
EC50	17.3	15.64	18.21	5.779	5.492	6.393

Combined Proportion Normal Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Negative Control	3	0.8205	0.7466	0.8824	0.03965	0.06867	8.37%	0.0%	544	663
6.2		3	0.8175	0.7964	0.8416	0.01315	0.02277	2.79%	0.37%	542	663
12.5		3	0.7662	0.7149	0.8643	0.04904	0.08493	11.08%	6.62%	508	663
25		3	0	0	0	0	0		100.0%	0	663
50		3	0	0	0	0	0		100.0%	0	663
100		3	0	0	0	0	0		100.0%	0	663

Combined Proportion Normal Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	0.7466	0.8326	0.8824
6.2		0.7964	0.8416	0.8145
12.5		0.8643	0.7149	0.7195
25		0	0	0
50		0	0	0
100		0	0	0

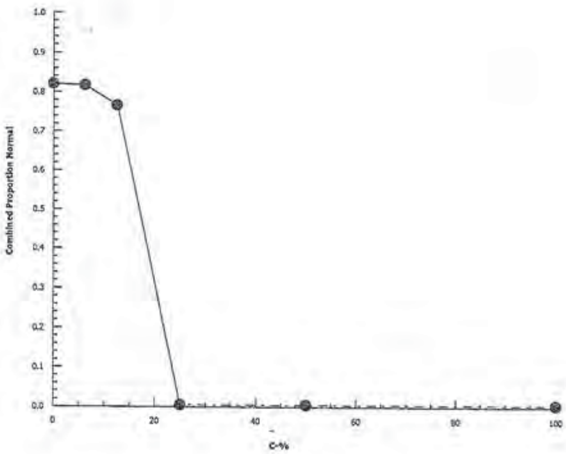
Combined Proportion Normal Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	165/221	184/221	195/221
6.2		176/221	186/221	180/221
12.5		191/221	158/221	159/221
25		0/221	0/221	0/221
50		0/221	0/221	0/221
100		0/221	0/221	0/221

Echinoid Embryo-Larval Survival and Development Test **Nautilus Environmental**

Analysis ID:	05-1129-3496	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	30 Aug-17 13:43	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Echinoderm Development Toxicity Test Data Sheet

Client: Golder
Sample ID: SED17-09, SED17-13
Test No.: 170469-TIE

Start Date & Time: May 26/17 @ 1500h
End Date & Time: May 30/17 @ 1500h
Test species: S. purpuratus

Concentration/ Treatment	Temperature (°C)					Dissolved oxygen (mg/L)					pH (units)					Salinity (ppt)				
	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
SW Control	14.5					7.6					7.6					28				
EDTA Control (20 mg/L)	14.0					8.3					7.6					28				
EDTA Control (100 mg/L)	14.0					8.2					7.0 ①					28				
C18 Control	14.0					8.3					7.8					28				
SED17-09	14.5					7.3					7.4					29				
-09 EDTA (20 mg/L)	14.0					7.8					7.4					29				
-09 EDTA (100 mg/L)	14.0					7.8					7.4					29				
-09 C18	14.0					7.7					7.6					29				
SED17-13	14.0					7.8					7.7					31				
-13 EDTA (20 mg/L)	14.0					7.9					7.7					31				
-13 EDTA (100 mg/L)	14.0					8.0					7.6					31				
-13 C18	14.0					8.0					7.7					31				
Analyst Initials																				

	Initial Water Quality			
Conc.	Temp	DO	pH	Salinity
Control				
100% sample				

Sample Description: ① Adjusted w/ 1M NaOH to 7.4

Test Set up by: JAB / YYL

Comments: 0 hrs:
24 hrs.
48 hrs.

Reviewed by: JCh

Date Reviewed: Sep. 11/17

Echinoderm Larvae Development Toxicity Test Data Sheet
Larval Counts – Porewater

Client: Golder
Work Order #: 170465-TIE
Sample ID: SED17-09, SED17-13

Start Date/Time: May 26, 2017 @ 1500h
Test species: S. purpuratus
Test set up by: JAB, YYL
Initial Density/ 10mL: 269

Concentration	Rep	No. Normal	No. Abnormal	Comments	Initials
Control SW	A	203	46		YYL
	B	208	53		
	C	178	45		
	D	185	40		
EDTA control (20 mg/L)	A	199	38		
	B	199	51		
	C	172	37		
	D	184	44		
EDTA Control (100 mg/L)	A	196	57		
	B	183	54		
	C	189	59		
	D	193	51		
C18 Control	A	191	41		
	B	181	47		
	C	187	48		
	D	208	46		
SED17-09	A	0	201		
	B	0	191		
	C	0	198		
	D	0	214		
SED17-09 EDTA (20 mg/L)	A	0	204		
	B	0	197		
	C	0	213		
	D	0	198		
SED17-09 EDTA (100 mg/L)	A	0	214		
	B	0	229		
	C	0	226		
	D	0	200		

Comments:

Reviewed by: [signature]
Date Reviewed: Sep. 11/17

Echinoderm Larvae Development Toxicity Test Data Sheet
Larval Counts

Client: Golder
Work Order #: 17049-TIE
Sample ID: SED17-09, -13
Start Date/Time: May 26/17 @ 1500h
Test species: S. purpuratus
Test set up by: JAB, YYL
Initial Density/ 10mL: 269

Concentration	Rep	No. Normal	No. Abnormal	Comments	Initials
~~Control~~ SED17-09 C18	A	0	184		MWL
	B	0	176		
	C	0	201		
	D	0	175		
SED17-13	A	14	209		
	B	2	229		
	C	7	216		
	D	9	227		
SED17-13 EDTA (20 mg/L)	A	21	222		
	B	9	223		
	C	6	239		
	D	12	230		
SED17-13 EDTA (100 mg/L)	A	16	230		
	B	21	215		
	C	20	216		
	D	10	226		
SED17-13 C18	A	8	220		
	B	11	207		
	C	8	201		
	D	12	209		
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				

Comments:

Reviewed by: JGL
Date Reviewed: Sep. 11/17

APPENDIX B - Analytical Chemistry

Nautilus Environmental
Water Quality Data For Ammonia

Client : Golder

Work Order No: 170469-TIE

Species : S. purpuratus

Sample Type: Porewater

Date Measured: July 7/17

Date	Sample ID	Temperature °C	Salinity (ppt)	pH	Total Ammonia as N (mg/L)	Unionized Ammonia (mg/L)	Tech. Init.
July 7/17	SED17-09	15.0	29	7.6	11.0	0.080	JAB
↓	SED17-13	15.0	29	7.7	5.0	0.045	↓
↓	SED17-22	15.0	29	7.8	37.0	0.423	↓
↓	25 mg/L Amm	15.0	29	7.7	26.0	0.237	CME

Ammonia Salicylate Lot #: A7150

Ammonia Cyanurate Lot #: A7152

Comments:

Reviewd by: JBh

Date Reviewed: Sep. 11/17

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August 9, 2017

Josh Baker
Nautilus Environmental Company Inc.
8664 Commerce Court
Burnaby, British Columbia
Canada V5A 4N7
josh@nautilusenvironmental.ca

RE: Project NAU-BC1702

Mr. Baker,

On July 12, 2017 Brooks Applied Labs (BAL) received five (5) porewater samples. The samples were logged-in for the analyses of dissolved Cu, Pb, Zn, and Hg, in accordance with the submitted chain-of-custody (COC) forms. Each sample had been field-filtered (0.45µm) by the client prior to receipt at BAL. All samples fractions for dissolved Cu, Pb, and Zn had also been field-preserved with nitric acid to a pH < 2. All samples were received, preserved, and stored according to BAL SOPs and EPA methodology.

Dissolved Metals Quantitation by ICP-QQQ-MS

Each preserved sample for dissolved Cu, Pb, and Zn quantitation was directly analyzed by inductively coupled plasma triple quadrupole mass spectrometry (ICP-QQQ-MS). The ICP-QQQ-MS determinative method uses advanced interference removal techniques to ensure accuracy of the sample results. For more information, please visit the *Interference Reduction Technology* section on our website, brooksapplied.com.

The recoveries of the internal standards for the submitted samples drifted above the control limit of 125% in sequence 1700873, to a maximum of 156%. The internal standard recoveries of the batch matrix spike and matrix spike duplicate also drifted upward, to a maximum of 141%. Despite the elevated internal standards, the recoveries of Cu, Pb, and Zn in the matrix spikes were all within acceptance limits. These acceptable matrix spike recoveries for the analytes of interest demonstrate that the internal standards appropriately corrected for the observed instrument drift. Consequently, no corrective action or qualification of the data was deemed necessary.

Dissolved Mercury using MERX

Each water sample was preserved with bromine monochloride in its initial container and then analyzed in accordance with EPA Method 1631E.

All sample results reported for Hg were method blank corrected, while all other analyte results were *not* method blank corrected, as described in the calculations section of the relevant BAL SOPs. All results were evaluated using reporting limits adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details.

In instances where a matrix spike/matrix spike duplicate (MS/MSD) set was spiked at a level less than the native sample concentration, the recoveries and the relative percent difference (RPD) are not considered valid indicators of data quality. In such instances, the recoveries of the laboratory fortified blanks (BS) and/or standard reference materials (SRM) demonstrate the accuracy of the applied methods. When the spiking level was less than 25% of the native sample concentration, the spike recovery was not reported (NR) and the relative percent difference (RPD) of the MS/MSD set was not calculated (N/C).

All data was reported without qualification and all other associated quality control results met the acceptance criteria.

BAL, an accredited laboratory, certifies that the reported results of all analyses for which BAL is NELAP accredited meet all NELAP requirements. For more information please see the *Report Information* page. Please feel free to contact us if you have any questions regarding this report.

Sincerely,

Ben Wozniak
Project Manager
ben@brooksapplied.com

Project ID: NAU-BC1702
PM: Ben Wozniak

Client PM: Joshua Baker
Client Project: NAU-BC1702

Report Information

Laboratory Accreditation

BAL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BAL is also certified by many other states to perform environmental analyses. For a current list of our accreditations/certifications, please visit our website at <http://www.brooksapplied.com/resources/certificates-permits/>. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

AR	as received	**MS**	matrix spike
BAL	Brooks Applied Labs	**MSD**	matrix spike duplicate
BLK	method blank	**ND**	non-detect
BS	blank spike	**NR**	non-reportable
CAL	calibration standard	**N/C**	not calculated
CCB	continuing calibration blank	**PS**	post preparation spike
CCV	continuing calibration verification	**REC**	percent recovery
COC	chain of custody record	**RPD**	relative percent difference
D	dissolved fraction	**SCV**	secondary calibration verification
DUP	duplicate	**SOP**	standard operating procedure
IBL	instrument blank	**SRM**	standard reference material
ICV	initial calibration verification	**T**	total fraction
MDL	method detection limit	**TR**	total recoverable fraction
MRL	method reporting limit		

Definition of Data Qualifiers

(Effective 9/23/09)

E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Result is estimated.
J	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
J-1	Estimated value. A full explanation is presented in the narrative.
J-M	Duplicate precision (RPD) for associated QC sample was not within acceptance criteria. Result is estimated.
J-N	Spike recovery for associated QC sample was not within acceptance criteria. Result is estimated.
M	Duplicate precision (RPD) was not within acceptance criteria. Result is estimated.
N	Spike recovery was not within acceptance criteria. Result is estimated.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.

These qualifiers are based on those previously utilized by Brooks Applied Labs, those found in the EPA SOW ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review; USEPA; January 2010. These supersede all previous qualifiers ever employed by BAL.

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Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
SED17-09	1728036-01	Water	Sample	07/07/2017	07/12/2017
SED17-13	1728036-02	Water	Sample	07/07/2017	07/12/2017
SED17-22	1728036-03	Water	Sample	07/07/2017	07/12/2017
-09 C18	1728036-04	Water	Sample	07/07/2017	07/12/2017
-09 EDTA	1728036-05	Water	Sample	07/07/2017	07/12/2017

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
Cu	Water	EPA 1638 Mod	07/14/2017	07/24/2017	B171717	1700873
Hg	Water	EPA 1631 E	07/18/2017	07/21/2017	B171720	1700870
Pb	Water	EPA 1638 Mod	07/14/2017	07/24/2017	B171717	1700873
Zn	Water	EPA 1638 Mod	07/14/2017	07/24/2017	B171717	1700873

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Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
-09 C18										
1728036-04	Cu	Water	D	≤ 0.200	U	0.200	1.00	µg/L	B171717	1700873
1728036-04	Hg	Water	D	≤ 0.51	U	0.51	2.02	ng/L	B171720	1700870
1728036-04	Pb	Water	D	≤ 0.125	U	0.125	0.375	µg/L	B171717	1700873
1728036-04	Zn	Water	D	≤ 1.50	U	1.50	10.0	µg/L	B171717	1700873
-09 EDTA										
1728036-05	Cu	Water	D	0.374	J	0.200	1.00	µg/L	B171717	1700873
1728036-05	Hg	Water	D	≤ 0.51	U	0.51	2.02	ng/L	B171720	1700870
1728036-05	Pb	Water	D	≤ 0.125	U	0.125	0.375	µg/L	B171717	1700873
1728036-05	Zn	Water	D	2.35	J	1.50	10.0	µg/L	B171717	1700873
SED17-09										
1728036-01	Cu	Water	D	0.229	J	0.200	1.00	µg/L	B171717	1700873
1728036-01	Hg	Water	D	≤ 0.51	U	0.51	2.02	ng/L	B171720	1700870
1728036-01	Pb	Water	D	≤ 0.125	U	0.125	0.375	µg/L	B171717	1700873
1728036-01	Zn	Water	D	≤ 1.50	U	1.50	10.0	µg/L	B171717	1700873
SED17-13										
1728036-02	Cu	Water	D	0.516	J	0.200	1.00	µg/L	B171717	1700873
1728036-02	Hg	Water	D	1.10	J	0.51	2.02	ng/L	B171720	1700870
1728036-02	Pb	Water	D	≤ 0.125	U	0.125	0.375	µg/L	B171717	1700873
1728036-02	Zn	Water	D	≤ 1.50	U	1.50	10.0	µg/L	B171717	1700873
SED17-22										
1728036-03	Cu	Water	D	0.608	J	0.200	1.00	µg/L	B171717	1700873
1728036-03	Hg	Water	D	0.62	J	0.51	2.02	ng/L	B171720	1700870
1728036-03	Pb	Water	D	≤ 0.125	U	0.125	0.375	µg/L	B171717	1700873
1728036-03	Zn	Water	D	≤ 1.50	U	1.50	10.0	µg/L	B171717	1700873

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Project ID: NAU-BC1702
PM: Ben Wozniak

Client PM: Joshua Baker
Client Project: NAU-BC1702

Accuracy & Precision Summary

Batch: B171717
Lab Matrix: Water
Method: EPA 1638 Mod

Sample	Analyte	Native	Spike	Result	Units	REC & Limits		RPD & Limits	
B171717-SRM1	**Standard Reference Material (1724007, T221 as SRM)**								
	Cu		3.780	3.551	µg/L	94%	75-125		
	Pb		0.4900	0.492	µg/L	100%	75-125		
	Zn		25.20	26.28	µg/L	104%	75-125		
B171717-SRM2	**Standard Reference Material (1721039, NIST 1640a (batch SRM))**								
	Cu		85.75	83.97	µg/L	98%	75-125		
	Pb		12.10	12.63	µg/L	104%	75-125		
	Zn		55.64	56.16	µg/L	101%	75-125		
B171717-DUP1	**Duplicate, (1728036-01)**								
	Cu	0.229		0.228	µg/L			0.2%	20
	Pb	ND		ND	µg/L			N/C	20
	Zn	ND		ND	µg/L			N/C	20
B171717-MS1	**Matrix Spike, (1728036-01)**								
	Cu	0.229	250.0	204.8	µg/L	82%	75-125		
	Pb	ND	25.00	19.61	µg/L	78%	75-125		
	Zn	ND	250.0	211.7	µg/L	85%	75-125		
B171717-MSD1	**Matrix Spike Duplicate, (1728036-01)**								
	Cu	0.229	250.0	205.6	µg/L	82%	75-125	0.4%	20
	Pb	ND	25.00	19.18	µg/L	77%	75-125	2%	20
	Zn	ND	250.0	210.6	µg/L	84%	75-125	0.5%	20

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Project ID: NAU-BC1702
PM: Ben Wozniak

Client PM: Joshua Baker
Client Project: NAU-BC1702

Brooks Applied Labs

Accuracy & Precision Summary

Batch: B171720
Lab Matrix: Water
Method: EPA 1631 E

Sample	Analyte	Native	Spike	Result	Units	REC & Limits		RPD & Limits	
B171720-SRM1	**Standard Reference Material (1727014, THg SRM NIST 1641d)**								
	Hg		15.68	15.03	ng/L	96%	80-120		
B171720-MS1	**Matrix Spike (1728014-04)**								
	Hg	5.14	20.41	21.83	ng/L	82%	71-125		
B171720-MSD1	**Matrix Spike Duplicate (1728014-04)**								
	Hg	5.14	20.41	23.59	ng/L	90%	71-125	8%	24
B171720-MS2	**Matrix Spike (1728014-10)**								
	Hg	5.95	20.41	23.37	ng/L	85%	71-125		
B171720-MSD2	**Matrix Spike Duplicate (1728014-10)**								
	Hg	5.95	20.41	22.93	ng/L	83%	71-125	2%	24
B171720-MS6	**Matrix Spike (1728038-01)**								
	Hg	4.61	20.41	22.18	ng/L	86%	71-125		
B171720-MSD6	**Matrix Spike Duplicate (1728038-01)**								
	Hg	4.61	20.41	24.61	ng/L	98%	71-125	10%	24
B171720-MS4	**Matrix Spike (1728069-04)**								
	Hg	570.1	1531	1934	ng/L	89%	71-125		
B171720-MSD4	**Matrix Spike Duplicate (1728069-04)**								
	Hg	570.1	1531	2035	ng/L	96%	71-125	5%	24
B171720-MS8	**Matrix Spike (1728074-04)**								
	Hg	28.43	101.0	115.3	ng/L	86%	71-125		
B171720-MSD8	**Matrix Spike Duplicate (1728074-04)**								
	Hg	28.43	101.0	130.7	ng/L	101%	71-125	13%	24

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Method Blanks & Reporting Limits

Batch: B171717
Matrix: Water
Method: EPA 1638 Mod
Analyte: Cu

Sample	Result	Units
B171717-BLK1	-0.003	µg/L
B171717-BLK2	0.002	µg/L
B171717-BLK3	-0.003	µg/L
B171717-BLK4	-0.0001	µg/L

Average: -0.001 **MDL:** 0.008
Limit: 0.040 **MRL:** 0.040

Analyte: Pb

Sample	Result	Units
B171717-BLK1	0.00003	µg/L
B171717-BLK2	-0.0001	µg/L
B171717-BLK3	-0.0004	µg/L
B171717-BLK4	-0.0003	µg/L

Average: 0.000 **MDL:** 0.005
Limit: 0.015 **MRL:** 0.015

Analyte: Zn

Sample	Result	Units
B171717-BLK1	-0.03	µg/L
B171717-BLK2	-0.03	µg/L
B171717-BLK3	-0.03	µg/L
B171717-BLK4	-0.02	µg/L

Average: -0.03 **MDL:** 0.06
Limit: 0.40 **MRL:** 0.40

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Method Blanks & Reporting Limits

Batch: B171720
Matrix: Water
Method: EPA 1631 E
Analyte: Hg

Sample	Result	Units
B171720-BLK1	0.21	ng/L
B171720-BLK2	0.17	ng/L
B171720-BLK3	0.10	ng/L
B171720-BLK4	0.14	ng/L

Average: 0.16	**Standard Deviation:** 0.05	**MDL:** 0.10
Limit: 0.50	**Limit:** 0.10	**MRL:** 0.40

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Sample Containers

Lab ID: 1728036-01 | **Sample:** SED17-09 | **Report Matrix:** Water | **Sample Type:** Sample | **Collected:** 07/07/2017 | **Received:** 07/12/2017

Des	Container	Size	Lot	Preservation	Pres-Lot	pH	Ship. Cont.
A	Client-Provided - Hg	120 mL	NA	None	NA	NA	Cooler
B	Client-Provided - TM	125 mL	NA	HNO3 (Client)	NA	<2	Cooler

Lab ID: 1728036-02 | **Sample:** SED17-13 | **Report Matrix:** Water | **Sample Type:** Sample | **Collected:** 07/07/2017 | **Received:** 07/12/2017

Des	Container	Size	Lot	Preservation	Pres-Lot	pH	Ship. Cont.
A	Client-Provided - Hg	120 mL	NA	None	NA	NA	Cooler
B	Client-Provided - TM	125 mL	NA	HNO3 (Client)	NA	<2	Cooler

Lab ID: 1728036-03 | **Sample:** SED17-22 | **Report Matrix:** Water | **Sample Type:** Sample | **Collected:** 07/07/2017 | **Received:** 07/12/2017

Des	Container	Size	Lot	Preservation	Pres-Lot	pH	Ship. Cont.
A	Client-Provided - Hg	120 mL	NA	None	NA	NA	Cooler
B	Client-Provided - TM	125 mL	NA	HNO3 (Client)	NA	<2	Cooler

Lab ID: 1728036-04 | **Sample:** -09 C18 | **Report Matrix:** Water | **Sample Type:** Sample | **Collected:** 07/07/2017 | **Received:** 07/12/2017

Des	Container	Size	Lot	Preservation	Pres-Lot	pH	Ship. Cont.
A	Client-Provided - Hg	120 mL	NA	None	NA	NA	Cooler
B	Client-Provided - TM	125 mL	NA	HNO3 (Client)	NA	<2	Cooler

Lab ID: 1728036-05 | **Sample:** -09 EDTA | **Report Matrix:** Water | **Sample Type:** Sample | **Collected:** 07/07/2017 | **Received:** 07/12/2017

Des	Container	Size	Lot	Preservation	Pres-Lot	pH	Ship. Cont.
A	Client-Provided - Hg	120 mL	NA	None	NA	NA	Cooler
B	Client-Provided - TM	125 mL	NA	HNO3 (Client)	NA	<2	Cooler

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Project ID: NAU-BC1702
PM: Ben Wozniak

Client PM: Joshua Baker
Client Project: NAU-BC1702

Shipping Containers

Cooler

Received: July 12, 2017 13:20
Tracking No: 9612019116911615276929 via FedEx
Coolant Type: Blue Ice
Temperature: 14.9 °C

Description: Cooler
Damaged in transit? No
Returned to client? No
Comments: IR#8

Custody seals present? No
Custody seals intact? No
COC present? Yes

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For more information, visit golder.com

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