Plan of Operations
Palmer Advanced Exploration Project
Haines, Alaska
Attachment 1
Monitoring Plan

Phase II – Underground Exploration
Upland Mining Lease No. 9100759

Prepared for:
Alaska Mental Health Trust Land Office
Alaska Department of Natural Resources
Alaska Department of Environmental Conservation

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March 2019, 2nd revision January 2023

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Version Control			
Version Number	**Date issued**	**Author**	**Update information**
V1.0	April 2019	CEM; (JD)	First version, issued as Attachment 1 of the Application for Waste Management Permit for the Palmer Phase II Exploration Project Haines Alaska Upland Mining Lease no. 9100759 (March 2019)
V2.0	October 2019	CEM; (AC)	Amended to include monitoring requirements listed under Section 2.5 of Waste Management Permit 2019DB0001, issued on July 17 2019.
V3.0	January 2022	CEM; (AC/JD)	Amended to update monitoring sites in response to updated LAD design (Appendix A of WMP, April 2022). Adjusted language around LAD in response to updated LAD design ("lower diffuser" is now referred to as "diffuser"). Removed MW-01 and MW-02 from monitoring plan (replaced with MW-05 and MW-04S). Removed MW-04 from monitoring program as the "upper diffuser" is no longer part of LAD design.

SUMMARY

This Monitoring Plan describes environmental monitoring that Constantine will continue to perform under this Phase II Plan of Operations. The monitoring plan has been revised to include conditions listed in Waste Management Permit 2019DB0001 ("WMP"), issued on July 17th 2019 (as per Section 2.5 of the WMP). The WMP authorizes the management and disposal of underground seepage water and waste rock associated with advanced exploration at the Palmer Project.

Constantine has completed a variety of environmental and characterization studies which include Acid Base Accounting, Aquatic Biomonitoring, Cultural Resources, Geology, Geotechnical, Water Quality, Groundwater Hydrology, Meteorology, Snow and Avalanche, Wetlands, Wildlife and Wildlife Habitat as a major step in characterizing the natural environment in the project area. Information derived from these studies was integrated into the project designs and plans with the intent of preventing unnecessary or undue degradation to the environment.

The monitoring done to-date has been largely motivated by Constantine's own initiative to understand the natural environment in which they operate and develop plans that are as least intrusive as possible. Except for the storm water inspections, and the groundwater monitoring of the LAD monitoring wells, none of the monitoring described in this plan is required by regulation but some of it may become a requirement of one or more forthcoming permits.

The data from these efforts contribute to a fundamental understanding of the natural environment baseline in the project area. They define an environmental backdrop against which Constantine can detect changes, over time, including those that might be detected concurrent with project activities.

Constantine will continue to perform the following monitoring as part of its ongoing exploration efforts at Palmer:

- Meteorological monitoring at two existing stations, in Glacier Creek and the ridge above the South Wall north of Glacier Creek
- Surface water quality sampling and flow measurements at sites P01, P27 in Glacier Creek, P25 in Waterfall Creek and P26 in Hangover Creek (as per Section 2.5.5.2 of the WMP)
- Groundwater quality monitoring at MW21-05 and MW21-04-S, located above and below the diffuser (replacing Section 2.5.5.1 of the WMP)
- Groundwater level monitoring in drillholes and monitoring wells near the LAD diffuser
- Underground seepage water quality sampling in the proposed exploration ramp
- Wastewater sampling after the last treatment process and before discharge (as per Section 2.5.5.4 of the WMP)
- Flow monitoring of discharged wastewater from the diffuser (as per Section 2.5.5.3 of the WMP)

- Incidental wildlife sightings by project personnel, including observations on wildlife health (as per Section 2.5.1 of the WMP)
- Visual inspection of LAD facilities for signs of damage (as per Section 2.51 of the WMP)
- Visual inspection of surface conditions around LAD for signs of stress or surface expression of wastewater (including wildlife, vegetation, and waters as per Section 2.5.1 of the WMP)
- Leachate sampling from the 4 ABA sample barrels located in Glacier Creek Valley
- Visual monitoring and periodic geochemical sampling of development rock from the underground exploration ramp (as per Section 2.5.4 of the WMP)
- Stormwater inspections as required by the Construction General Permit and Multi-Sector General Permit

Each is discussed in this monitoring plan. This plan is a living document subject to change in response to new information or changes in monitoring or new permitting requirements. Constantine reserves the right to modify this plan for any reason except for any monitoring that is, or becomes, a requirement under a permit or authorization.

1.0 ENVIRONMENTAL MONITORING

Constantine has been performing several environmental monitoring and characterization programs for the project starting as early as 2008. Most of these programs started in 2014.

Past environmental monitoring and characterization studies have included Acid Base Accounting, Aquatic Biomonitoring, Cultural Resources, Geology, Geotechnical, Water Quality, Groundwater Hydrology, Meteorology, Snow and Avalanche, Wetlands, Wildlife and Wildlife Habitat as an important step in characterizing the natural environment in the project area. Information derived from these studies was integrated into the project designs and plans, with the intent of preventing unnecessary or undue degradation to the environment.

The monitoring and characterization work done to-date has been largely motivated by Constantine's initiative to understand the natural environment in which they operate and to develop project plans that are compatible with the local environment.

The data from these efforts contribute to a fundamental understanding of the natural environment baseline in the project area. They define an environmental backdrop against which Constantine can detect changes, over time, including those that might be concurrent with project activities.

This monitoring plan describes all the monitoring that Constantine will perform as part of their continuing exploration activities for the Palmer Project. The monitoring described in this plan includes, but is not exclusive to, monitoring required by Construction and Multi-Sector General Permits for stormwater, and Waste Management Permit 2019DB0001, issued by ADEC on July 17, 2019. Additional monitoring may be required as stipulations in forthcoming permits and approvals. Constantine reserves the right to change this plan, except for monitoring that is, or becomes, a requirement under any of the project permits or authorizations.

1.1 Meteorological Monitoring

Precipitation, temperature, solar radiation, wind speed and direction, relative humidity and snow depth data are collected at one station along the Glacier Creek access road, and temperature, wind speed and direction data (primarily to assist with avalanche forecasting) are collected from a second station, located on the ridge north of Glacier Creek (South Wall). The station on the access road has been operational since 2014 and the other since 2016. The data are collected in accordance with a QAPP for each station. Monitoring will continue at both stations.

1.2 Surface Water Monitoring

Constantine has been performing surface water quality sampling since 2008 from as many as 27 stations, and surface water quantity measurements from 13 stations since 2014. Details regarding this baseline sampling is available (Integral 2018; and Appendix B of Waste Management Permit Application). The sampling completed to date serves to establish a robust baseline of water quality and flows in, and surrounding, the Palmer project area. Now that Constantine has characterized the surface water quality and flows in the broader Palmer project area, the company plans to reduce the total number of surface water quality and flow sample sites. Reductions in the scope of environmental baseline monitoring are common for advanced exploration projects following collection of sufficient data to characterize an area somewhat larger than the anticipated footprint of the project.

1.2.1 Surface Water Quality Monitoring

Constantine will continue water quality sampling at sites P01 and P27 in upper and mid-Glacier Creek, respectively, P26 in Hangover Creek and P25 in Waterfall Creek during the underground exploration program as shown in Figure 1. These sites are the most relevant sites for detecting changes in water quality, over time, that may be coincide with Constantine's underground exploration activities which are restricted to the upper Glacier Creek area. Sampling frequency of P01, P27, P25 and P26 will be quarterly (as per Section 2.5.5 of the WMP).

Water quality sampling and analytical procedures are performed in accordance with Constantine's QAPP, prepared by Integral Consulting in 2018 and revised by HDR in October 2019 (as per Section 2.5.5.6 of the WMP). The QAPP is included as an appendix to this monitoring plan.

Samples are analyzed by ALS for conventional parameters, settleable solids, cations/anions, total/dissolved metals following SM and EPA methods (see Section B.4 of Appendix A, QAPP). Field parameters are also collected at each site during the sampling event. Appendix A provides the list of parameters and measurement quality objectives for the surface water quality samples (see Table A7-1 in Appendix A of QAPP, Water Sampling Measurement Quality Objectives).

1.2.2 Surface Water Flow Monitoring

Constantine has been monitoring surface water flows at 13 sites in Glacier Creek since 2014. Outside the project area additional water levels are measured at two USGS stations and Constantine's station P14B (a.k.a. station KR). Details on baseline hydrological conditions outside the project area are discussed by Integral (2018) and HDR (2022 *in progress*).

Glacier Creek and its tributaries provide the primary drainage within the Palmer project area, ultimately flowing into the Klehini River.

When it is safe to do so (dangerous during high flows) Constantine will continue to measure stream flows at the same four sites that it will continue to monitor surface water quality: P01, P27, P25 and P26 as illustrated in Figure 1.

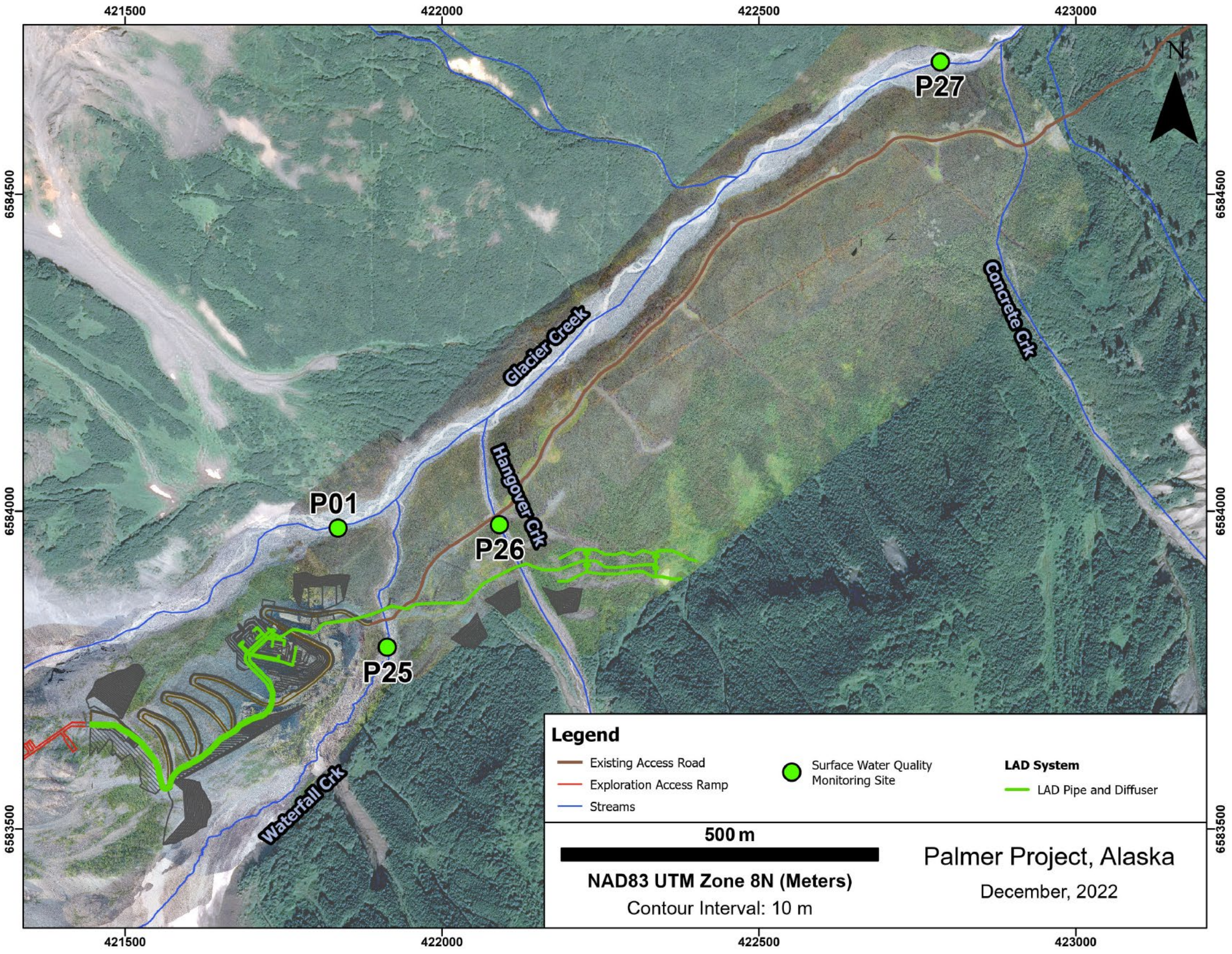

Figure 1. Surface Water Quality Monitoring Stations for Waste Management Permit

1.3 Groundwater Monitoring

Constantine has been performing groundwater quality sampling and monitoring groundwater levels in drillholes which it plans to continue. It also intends to start monitoring underground seepage inflows as the proposed underground ramp advances. Each is described in more detail below.

1.3.1 Groundwater Quality Monitoring

Constantine has been performing groundwater quality sampling since 2014. An initial objective of the sampling was to characterize groundwater as a step in predicting the quality of seepage water inflows into the proposed underground ramp. Sampling was performed in accordance with Constantine's QAPP.

Constantine samples a number of monitoring wells on the South Wall and in overburden. Constantine intends to continue groundwater sampling, including sampling select underground seepage water inflows. Monitoring these existing sites (and any future underground sites) is being done currently as part of Constantine's voluntary baseline monitoring program and Constantine may modify the monitoring of some of these sites.

In 2021 Constantine developed two groundwater monitoring wells above and below the proposed LAD diffuser site (MW-05 and MW-04S respectively) and has been collecting water quality samples from both. Groundwater monitoring sites are depicted on Figure 2 and Figure 3. The results of the sampling are being used primarily to characterize the natural groundwater quality for the area and secondarily to help predict the water quality of the anticipated underground seepage water. The water quality samples will also provide a basis for comparison after Constantine starts discharging treated water through the LAD diffuser. . Samples at MW-05 and MW-04S will be collected quarterly (as per Section 2.5.5 of the WMP). Note that MW-05 is shallow and often runs dry; the well will be re-drilled in 2023.

1.3.2 Groundwater Level Monitoring

Constantine has measured groundwater levels in roughly 30 drillholes and monitoring wells using pressure transducers and continues to do so in the majority of these as listed in Table 1and illustrated in Figure 2. The original wells have more than an eight-year water level record. Water level data are captured every 6-12 hours at each well using a pressure transducer datalogger. Data is analyzed every two years and compared with previous data for trends or significant changes. The last full evaluation was in 2021. Constantine will continue to monitor the water level in these drillholes and monitoring wells, including MW-05 and MW-04S above and below the LAD diffuser site.

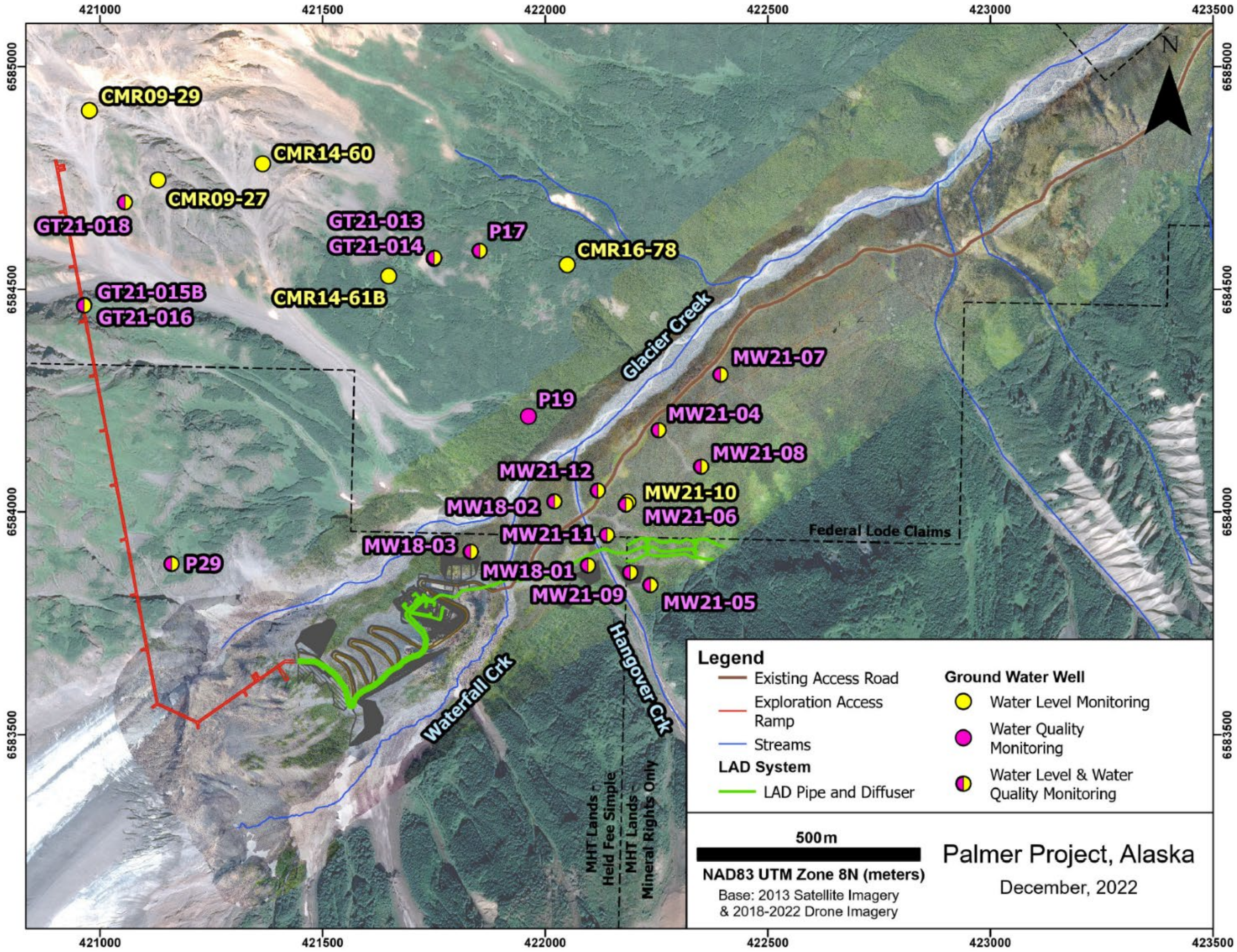

Figure 2. Groundwater Monitoring Location Map

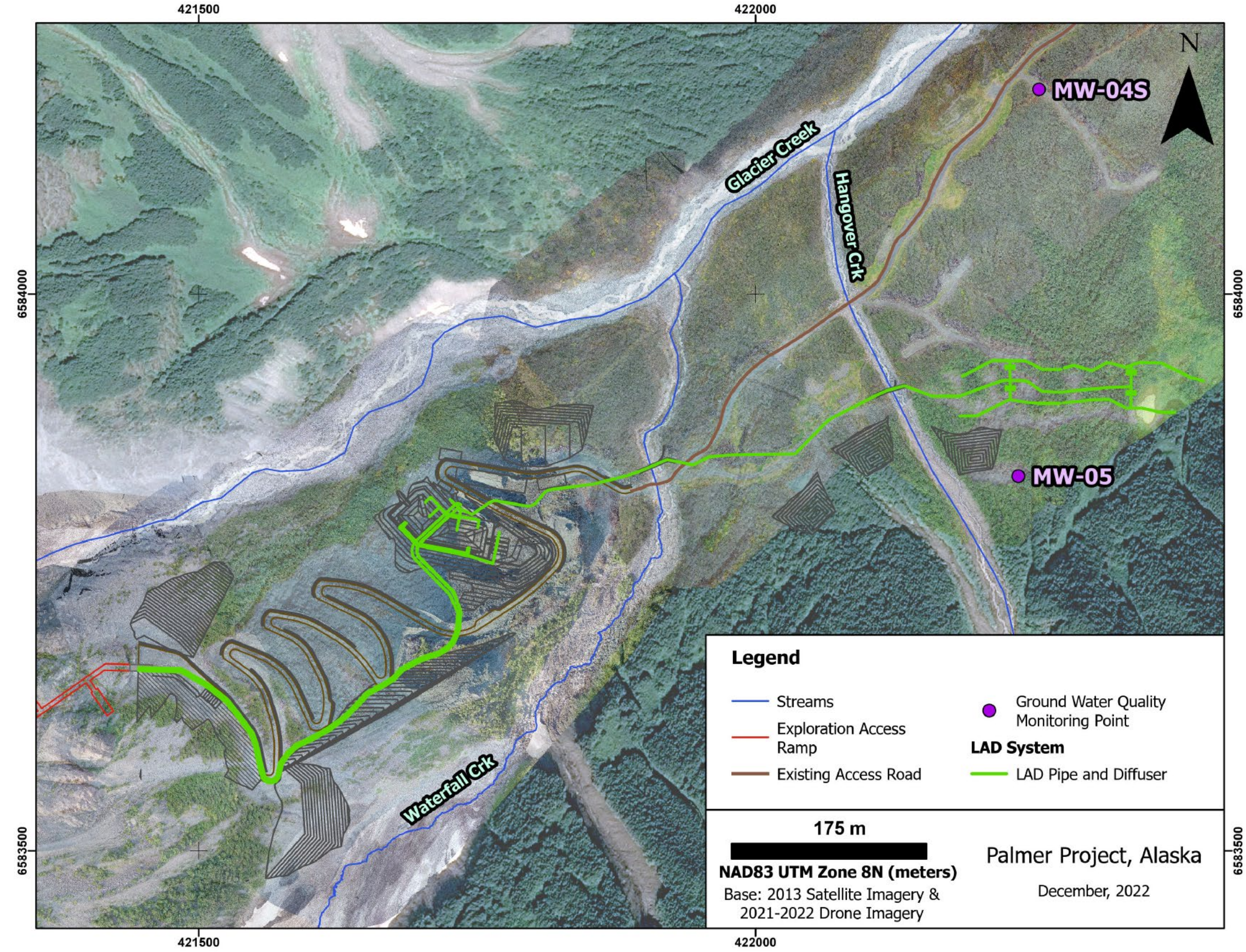

Figure 3. Groundwater Quality Monitoring Stations for Waste Management Permit

Table 1. List of Groundwater Level Monitoring Wells

Hole ID	Pad	Elevation (masl)	Azimuth	Dip	Length (m)	Screened (mbtoc)	Monitoring Start	Monitoring End	Period (yr)	Status
CMR09-27	Long	1193	337	-48	395	N/A	07-Oct-14	na	8	Active
CMR09-29	JP	1357	340	-53	362	N/A	07-Oct-14	na	8	Active
CMR13-52	Stryker	1322	153	-72	290	N/A	13-Jul-15	na	7.5	Active
CMR14-58	Green	1246	342.28	-60	833	N/A	06-Oct-14	01-Jun-15	0.7	Dropped
CMR14-60	Marmot	1097	316.65	-68	370	N/A	07-Oct-14	na	8	Active
CMR14-61B	Brazil	815	0.2	-50	626	N/A	06-Oct-14	na	8	Active
CMR15-76	Pocket	587	0.3	-46.4	455	N/A	30-Jun-16	12-Sep-16	0.2	P&A 2018
CMR16-78	Taz	701	359.1	-50.7	320	N/A	23-Aug-16	na	6	Active
GT14-01	U6	781	279.82	-5	302	artesian	19-Aug-18	na	4	Active
GT17-05	Hari	899	334.13	-15.47	293	artesian	07-Sep-17	na	5	Active
GT21-013	Money	804	194.2	-50	131	114.1 - 129.3	03-Oct-21	na	1	Active
GT21-014	Money	804	177.39	-85.27	306	290 - 305.2	03-Oct-21	na	1	Active
GT21-015B	Ridge B	1127	348.35	-57.8	478	462.2 - 477.5	03-Oct-21	na	1	Active
GT21-016	Ridge B	1126	327	-85	51	35.1 - 50.3	03-Oct-21	na	1	Active
GT21-018	KD	1171	278	-84	36	29.6 - 35.7	26-Sep-21	na	1	Active
MW18-01	N/A	576	0	-90	20	11.1 - 20.2	23-Aug-18	na	4	Active
MW18-02	N/A	532	0	-90	22	14.2 - 21.8	22-Aug-18	na	4	Active
MW18-03	N/A	547	0	-90	22	9.5 - 21.7	23-Aug-18	na	4	Active
MW21-04S	N/A	512	0	-90	46	43 - 46	20-Oct-21	na	1	Active
MW21-04D	N/A	512	0	-90	32	29 - 32	10-Nov-21	na	1	Active
MW21-05	N/A	608	0	-90	32	28.7 - 31.7	10-Nov-21	na	1	Active
MW21-06S	N/A	551	0	-90	66	63.4 - 66.5	20-Oct-21	na	1	Active
MW21-06D	N/A	551	0	-90	57	54.3 - 57.3	20-Oct-21	na	1	Active
MW21-07S	N/A	495	0	-90	48	44.8 - 47.9	20-Oct-21	na	1	Active
MW21-07D	N/A	495	0	-90	19	15.5 - 18.6	10-Nov-21	na	1	Active
MW21-08S	N/A	532	0	-90	54	51.2 - 54.5	10-Nov-21	na	1	Active
MW21-08D	N/A	532	0	-90	36	32.9 - 36	10-Nov-21	na	1	Active
MW21-09S	N/A	594	0	-90	75	72 - 75	20-Oct-21	na	1	Active
MW21-09D	N/A	594	0	-90	26	23.2 - 26.2	10-Nov-21	na	1	Active
MW21-10	N/A	551	0	-90	27	6.1 - 27.4	20-Oct-21	na	1	Active
MW21-11S	N/A	567	0	-90	69	65.5 - 68.6	20-Oct-21	na	1	Active
MW21-11D	N/A	567	0	-90	27	24.4 - 27.4	10-Nov-21	na	1	Active
MW21-12S	N/A	540	0	-90	52	49.9 - 52.4	20-Oct-21	na	1	Active
MW21-12D	N/A	540	0	-90	18	15.2 - 18.3	10-Nov-21	na	1	Active

1.3.3 Underground Seepage Monitoring

Water Quality

After Constantine begins excavating the exploration ramp it will collect seepage water quality samples on an opportunistic basis. For example, when there is enough seepage inflow to provide a sample, samples will be collected on a quarterly basis.

Constantine may have opportunities to sample pristine seepage water (i.e. from pilot or exploration drillholes). If artesian drillholes are encountered Constantine will install a valve in at least one of these holes to provide opportunities for quarterly sampling.

Modeling of predicted seepage inflow volumes performed by Tundra (2021) suggests that inflows may increase in the damage zone around the Kudo Fault. Under this circumstance there may be increased opportunities to collect seepage samples as the ramp advances.

1.3.4 Wastewater Monitoring

Water Quality

Wastewater will be sampled after the last treatment process and before the discharge (as per Section 2.5.5.4 of the WMP); this sampling will most likely occur as a grab from the pipe carrying the wastewater. Sampling will occur on a quarterly basis.

Flow

Flow of discharged wastewater from the diffuser must be measured continuously to assure that it does not exceed its design daily average flow rate (Section 2.5.5.3 of the WMP).

1.4 Visual Monitoring

1.4.1 Wildlife

Wildlife and habitat studies were initiated by consultant Hemmera (now J. Hobbs Ecological Consulting Inc.) in 2014 and performed seasonally through 2017. Hobbs Ecological continues to advise Constantine on matters related to wildlife. Terrestrial mapping for wildlife habitat and assessment for suitability for wildlife species of interest were done and resident species of interest were identified. Mountain Goat surveys continue in the project area seasonally (since 2014). Bird surveys (song birds and birds of prey) were also completed. Incidental wildlife observations are reported by Palmer Project employees using digital geo-referenced reporting forms. Constantine personnel have identified the following wildlife in the area: black and brown bear, mountain goat, coyote, wolf, red fox, moose, Steller's Jay, Rock Ptarmigan, Belted Kingfisher, Golden Eagle, Red-tailed Hawk, Hoary Marmot and ground squirrels.

During exploration operations Constantine will continue the incidental wildlife observation program that is implemented by project personnel. In addition, any stressed or injured wildlife will be reported immediately and documented on a monthly basis (as per Section 2.5.1 of the WMP).

1.4.2 Vegetation

During exploration operations, vegetation at the LAD facility will be surveyed for signs of stress during operations on a weekly basis and documented on a monthly basis (as per Section 2.5.1 of the WMP). Examples of stress include abnormal coloring of leaves, wilting and/or dropping of leaves, and misshapen leaves.

1.4.3 Waters

Visual monitoring of surface and groundwaters near the site will aim to ensure natural conditions are protected during LAD operations. Waters will be monitored for elevated turbidity and abnormal changes in color or smell. Sheen on discharged water, or the presence of aufeis (sheet like mass of layered ice that forms from successive flows of groundwater) will be monitored for. This monitoring will occur on a weekly basis and will be documented monthly (as per Section 2.5 of the WMP).

1.4.4 LAD Infrastructure

The LAD facilities will be visually monitored for signs of damage or potential damage from settlement, ponding, leakage, instability, frost action, thawing of waste, or operations at site. This monitoring will occur on a weekly basis and will be documented monthly (as per Section 2.5.1 of the WMP).

Daily inspection of the diffuser will occur during discharge periods (as per Section 2.5.3 of the WMP), which includes a visual inspection for new seeps in the area below the diffuser.

1.5 Development Rock Monitoring

Constantine initiated a rock characterization program in 2014. The purpose of the program was to characterize the various rock types at Palmer in terms of their capacity to generate acid and/or leach metals (ARD/ML) into the environment if they were subjected to the surface weathering environment. The study was expanded in 2017 to include additional core samples and surface outcrop samples that are representative of the rock types that will be intersected by the proposed underground ramp. 101 rock samples from drill core and surface outcrops have been analyzed to generate a baseline ARD/ML characterization of the rocks that Constantine will encounter in the proposed underground ramp. In addition to this work, field barrel kinetic tests and parallel laboratory humidity cell leach tests have been performed on samples representing the three main rock types expected in the ramp (work detailed in pHase, 2019).

Field barrel kinetic tests are on-going, and Constantine is committed to continue monitoring the leachate during the ice-free season.

The results of the ABA analyses, humidity cell studies and barrel tests all indicate that the rocks that the ramp will likely intersect will be non-PAG and non-metal leaching, even after being exposed to the surface environment.

Nonetheless, Constantine will implement the following monitoring and segregation activities for development rock generated while excavating the underground ramp (as per Part 3.2 Development Rock Monitoring, Handling and Disposal of the Permit application and Section 2.5.4 of the WMP):

- Monitor each blast round by performing a visual geologic examination as it is delivered to the portal pad. Geologist will record - rock lithology, sulfide species and concentration, intensity of effervescence using dilute HCl.

- Permanently dispose of all blast rounds with less than 2% sulfide in one of the three rock dumps, the avalanche berm or the avalanche deflection mounds.

- Collect a grab sample from each round with greater than 2% sulfide and submit the sample for ABA analysis and temporarily store the round on the lined storage pad adjacent to settling pond #2, pending results of ABA analyses of that round.

- Continue to store confirmed PAG rounds on the lined storage pad for rounds where the ABA analysis indicates a net neutralizing potential (NP:AP) less than 2.

- Haul the confirmed PAG rounds back underground for permanent disposal at the end of exploration program.

- Monitor active development rock disposal sites (rock dumps 1, 2 and 3, avalanche deflection mounds and berms) by collecting quarterly composite grab samples from and submit those samples for ABA analyses.

- Maintain records that describe where each round originated underground, the details the visual geologic inspection results and describe where each round was disposed on the surface, which rounds were tentatively identified as PAG and subject to ABA analyses. These records will also include the results of the ABA analyses. Finally, the records will describe where quarterly samples are collected and the results of the ABA analyses for those samples.

These are described in more detail below.

Assign Unique Designation to Each Round

Underground ramp development will proceed utilizing a typical drill-blast-muck cycle. Each round will consist of the blast rock (muck) from a single blast and represent approximately 10 feet of ramp advancement. Constantine will develop a system of uniquely identifying each round of muck. Typical approaches include the date and shift (night vs. day), data and blast time or date and distance from an underground survey monument.

Monitor Each Blast Round - Perform Geologic Examination

Depending on the selected haul trucks for the project, muck from each round will either be hauled to the surface and placed in a discrete pile on the portal pad or hauled directly from underground to a long-term rock storage pile on the surface. While each round is on the portal pad, or while it is still underground a geologist will examine the characteristics of each round. The geologists will determine 1) the basic lithology (Jasper Mtn basalt, Hangingwall basalt, Argillite, Mafic dike, or a mix, etc.), 2) the average sulfide content as a percentage of the volume of the rock, 3) the types of sulfides (pyrite, pyrrhotite etc.). The geologist will also apply dilute HCl to the rock and establish the amount of effervescence (strong, moderate or weak).

Permanently Dispose of Rounds with 2% or Less Sulfide

Once the geologist has examined the round and established that the total average sulfide content for the round is 2% or less, he will release the round so it can be hauled to the surface and be permanently disposed of in one of the three surface rock dumps, the avalanche berm or the avalanche deflection mounds, or a combination of these sites or used elsewhere for construction and/or maintenance as needed. The geologist will track and record the site used for final disposal.

Segregate and Sample Rounds with Greater than 2% Sulfide

If the geologic examination of any round establishes the presence of more than 2% average sulfide content by volume, the geologist will collect a representative random grab sample of the round. The sample will weigh at least 4 kilograms and the geologist will sample randomly from the entire muck pile to ensure that it is representative of that entire round. The sample will be sent to a certified laboratory and subjected to acid base accounting analytical procedures appropriate to establish the ratio of neutralizing potential to the acid-generating potential. The muck pile will be moved to the designated lined temporary storage site, and stored there pending the results of the ABA analyses. If the ABA analyses indicates an NP:AP ratio of 2 or more (i.e. non-PAG) then the muck pile may be moved to any other location for permanent disposal. If the NP:AP ratio is less than 2 then the muck pile will remain on a lined pad until it is placed back underground permanently.

Monitor Active Development Rock Disposal Sites by Collecting Quarterly Grab Samples

Following the visual geologic inspection, non-PAG rounds will be routinely and permanently disposed on the surface in any of rock dumps 1, 2 and 3, avalanche mounds or avalanche deflection berm. At the beginning of each quarter, Constantine will employ a geologist to collect a random grab sample from each of the disposal sites where muck was placed in the previous quarter and subject those samples to acid base accounting analytical procedures appropriate to establish the NP:AP ratio. This is being done to confirm the non-PAG nature of the muck piles.

Maintain Records

During the entire underground development program Constantine will maintain records that include the information generated as a result of the implementation of this development rock handling plan including:

- Record the unique identifying number/name for every underground round including sufficient information to establish the original location of that round underground.
- Record the observations of the geologist for each round including at least the lithology, sulfide concentration and types, and results of the HCl fizz test.
- Record the ABA laboratory sample number for any rounds with greater than 2% sulfide and the ABA analytical results once they are received from the lab.
- Record the final disposal location for each round including the date it was hauled to that location.
- Record a description of quarterly ABA samples including lithology, sulfide content and results of fizz test and a description of the approximate location of the sample and identification of the sample disposal site (i.e. upper half of avalanche berm or southernmost avalanche mound or portal disposal site) and the ABA analytical results once they are received from the lab.

1.6 STORM WATER MONITORING

Constantine is doing requisite storm water monitoring (inspections) currently under its Construction General Permit (CGP AKR100000) to manage storm water runoff from its road construction and other surface disturbance activities. Constantine has developed a SWPPP that describes the storm water inspections it performs during the activities described in this Plan of Operations. The inspection location and scope are defined by Section 4 of the 2022 CGP. Inspections are performed on a weekly schedule (excluding winter shut-down periods) as required by section 4.2 of the CGP that applies to sites where the mean annual precipitation exceeds 40 inches. An inspection report will be completed for each inspection in accordance with CGP Section 4.7. Upon completion of all surface construction activities (settling ponds, LAD, diffuser, portal pad) Constantine will be transitioning over to the Multi-Sector General Permit (AKR060000) for stormwater at the start of underground ramp development activities and will follow monitoring/inspection schedule in the MSGP SWPPP.

Appendix A Water Quality Sampling QAPP (HDR, 2019)

PALMER PROJECT

Quality Assurance Project Plan for Baseline Water Quality Monitoring

Prepared for

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October 2019

A. PROJECT MANAGEMENT ELEMENTS

A.1 Title and Approvals

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Signature: ____________________________ Date: ____________

A.2 Table of Contents

A.2.1 LIST OF FIGURES

A.2.2 LIST OF TABLES

A.2.3 ACRONYMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
ALS	ALS Laboratory Group
CALA	Canadian Association for Laboratory Accreditation Inc.
Constantine	Constantine North Inc.
COC	chain of custody
DMRQA	Discharge Monitoring Report Quality Assurance
DQO	data quality objective
EDD	electronic data deliverable
EDTA	ethylenediaminetetraacetic acid
EPA	U.S. Environmental Protection Agency
IDL	instrument detection limit
LIMS	laboratory information management system
MDL	method detection limit
MQO	measurement quality objective
MRL	method reporting limit
NELAP	National Environmental Laboratory Accreditation Program
PARCC	precision, accuracy, representatives, completeness, and comparability
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RPD	relative percent difference
SM	Standard Methods for the Examination of Water and Wastewater
SOP	standard operating procedure
TDS	total dissolved solids
TSS	total suspended solids
USGS	U.S. Geological Survey
WAD	weak acid dissociable
WMP	Waste Management Permit

A.3 Distribution List

Distribution List				
Name	**Position**	**Agency/ Company**	**Division/ Branch/ Section**	**Contact Information**
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A.4 Project/Task Organization

This section presents the organizational structure for activities associated with the Palmer exploration project, including project management and oversight, fieldwork, sample analysis, and data management. Duties and responsibilities of key individuals are described below. The organizational structure for the Palmer Project activities is illustrated in the organization chart provided in Figure A4-1 and in Table A4-1. Project lead individuals and their responsibilities are listed described below.

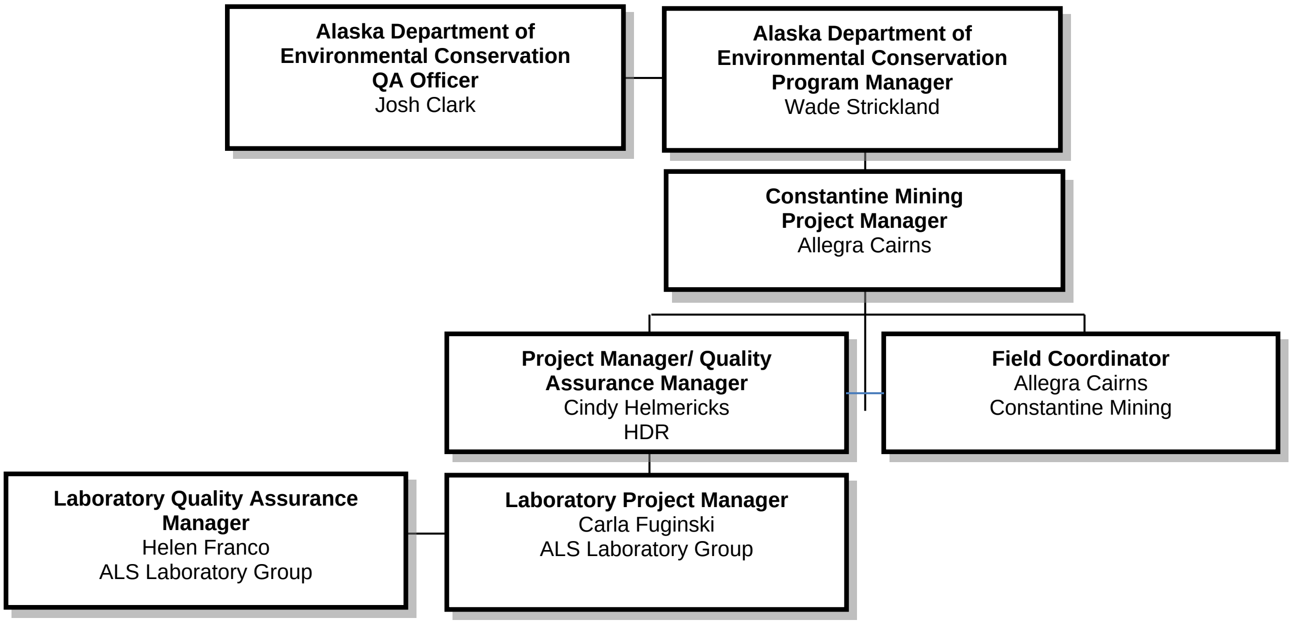

Figure A4-1. Palmer Project QAPP Organization Chart

A.4.1 Alaska Department of Environmental Conservation Organization and Responsibilities

Alaska Department of Environmental Conservation (ADEC) is the lead agency for all activities related to this project. The ADEC program manager and Quality Assurance (QA) Officer will oversee the activities associated with the Palmer Project and approve this quality assurance project plan (QAPP). Specifically, these roles involve:

- Program Manager—Responsible for overall technical and contractual management of the project.
- Quality Assurance Officer—Responsible for QA review and oversight of QA activities; ensures that collected data meets the project’s stated data quality and data reconciliation goals.

A.4.2 Constantine Mining and Consultants Organization and Responsibilities

Constantine North Inc. (Constantine), a wholly owned U.S. subsidiary of Constantine Metal Resources Ltd., is Operator of the Constantine Mining LLC Palmer Joint Venture. Qualified contractors will coordinate laboratory services, data collection, data quality reviews, and data management by providing QAPP development, data management, reporting, and field sampling consulting support to Constantine. Previously Integral Consulting, Inc authored the QAPP and performed these activities. Beginning February 2019, HDR took over the responsibility of performing the aforementioned activities and updated this current QAPP. The project leads and their duties are described below.

Constantine Project Manager—The Constantine project manager is responsible for final approval of the QAPP and all products submitted to ADEC for this project.

Field Coordinator—The field coordinator oversees sample collection activities. The field coordinator will be responsible for collecting samples and field measurements, completing field sampling logs and chain-of-custody documentation, and shipping samples to the analytical laboratory. The field coordinator will document any deviations from the QAPP and report these deviations to the project managers.

Project Manager—The project manager will oversee implementation of the field program, including execution of this QAPP.

Quality Assurance Manager—The QA manager for analytical chemistry will be responsible for the following activities:

- Coordinate the activities of the laboratories and track laboratory progress
- Receive analytical results from the laboratory
- Verify that the laboratories implement the requirements of the QAPP and address QA issues related to laboratory analyses
- Ensure that laboratory capacity is sufficient to undertake the required analyses in a timely manner
- Address scheduling issues related to laboratory analyses
- Direct the validation of the chemical data
- Communicate data quality issues to the data users
- Work with data users to address any data limitations.

A.4.3 Analytical Laboratory Organization and Responsibilities

ALS Laboratory Group (ALS) will provide analytical chemistry testing services.

Laboratory Project Manger—The ALS project manager has overall responsibility for the successful and timely completion of sample analyses for this project. The laboratory project manager will be responsible for the following tasks:

- Ensure that samples are received and logged in correctly, that the correct methods and modifications are used, and that data are reported within specified turnaround times

- Review analytical data to ensure that procedures were followed as required in this QAPP, the cited methods, and laboratory standard operating procedures (SOPs)
- Keep the QA manager apprised of the schedule and status of sample analyses and data package preparation
- Notify the QA manager if problems occur in sample receiving, analysis, or scheduling, or if control limits cannot be met
- Take appropriate corrective action, as necessary
- Report data and supporting QA information, as specified in this QAPP.

Laboratory Quality Assurance Manager—The ALS QA manager will be responsible for overseeing the QA activities in the laboratory and ensuring the quality of the data for this project. Specific responsibilities include the following:

- Oversee and implement the laboratory's QA program
- Maintain QA records for each laboratory production unit
- Ensure that quality assurance/quality control (QA/QC) procedures are implemented as required for each method and provide oversight of QA/QC practices and procedures
- Review and address or approve non-conformity and corrective action reports
- Coordinate responses to any QC issues that affect this project with the laboratory project manager.

A.5 Problem Definition/Background and Project Objectives

A.5.1 Problem Definition

Constantine seeks to sample water quality per the requirements of the Waste Management Permit 2019DB0001 (WMP) issued on July 17, 2019 and continue to develop a baseline water quality data set for surface streams and groundwater in the vicinity of the Palmer Project site. This QAPP specifies procedures and criteria to ensure that data collected and analyzed for this project will be valid and verifiable. The purpose of the data collection associated with this QAPP is to monitor potential effects from the project and to assemble a sufficient data set to define baseline conditions for target analytes in surface and groundwater. Baseline water quality data will be used to characterize water quality typical of the Palmer Project area prior to mine development.

A.5.2 Project Background

This QAPP provides guidelines for monitoring surface, ground, and wastewater quality in accordance with the requirements of the WMP and continue baseline sampling, to ensure that data of sufficient quantity and quality are collected to determine typical water quality conditions in the absence of significant site disturbance from mineral exploration and related activities.

The Palmer Project is a copper-zinc-silver-gold mineral exploration project currently in the resource delineation stage. The property is located in southeastern Alaska approximately 35 miles northwest of the town of Haines, at the northern limit of the Alaska Marine Highway (Figure A5-1). The western property boundary lies along the international border and the province of British Columbia. Geographic property coordinates are approximately 136° 25' N, 59° 20' W. The project consists of 340 federal unpatented lode mining claims, which cover an area of approximately 6,567 acres, 63 state mineral claims that cover an area of approximately 9,200 acres, and two mental health trust parcels that cover an area of approximately 66,000 acres.

The Palmer property is located on the eastern edge of the Saint Elias Mountains, with a range in elevations from approximately 1,000 ft to 6,000 ft. Vegetation in low elevations consists of coastal rainforest, while high elevations are barren of vegetation and partly covered by permanent snow and ice fields. Site temperatures range from -13°F in winter to 77°F in the summer. Snowfall in higher elevations limits surface based mineral exploration work to May through October.

The Klehini River runs from west to east along the northern property boundary. Drainages within the project area include Glacier Creek, Jarvis Creek, and their tributaries. Klehini River average daily flows range from 100 to 9,000 cfs, with peak flows occurring in July and August and baseflows from November through May.

In 2006, Constantine began exploratory drilling, leading to the discovery of high-grade copper and zinc mineralization. The exploration drill program is seasonal, with helicopter-supported drill activity typically extending from late May until early October in each calendar year.

A.5.3 Project Objectives

This QAPP outlines procedures for collecting regulatory required monitoring data for surface, ground, and wastewater. In addition, baseline surface water quality data and groundwater quality data. Monitoring data will be used to meet the requirements as outlined in the WMP. Baseline surface and groundwater quality data will be used to characterize water quality typical of the Palmer Project area prior to mine development. Baseline data will define natural conditions for the area and may be used in the future to establish natural conditions-based water quality criteria.

A.6 Project/Task Description and Schedule

A.6.1 Project Description

Monitoring data sampling occurs at defined surface and ground, and wastewater locations as described in the WMP on Figures 6.3 and 6.4. Wastewater is to be collected between the last treatment process and before discharge. Water quality monitoring required parameters include total metals, field parameters, conventional parameters , and major anions.

Water quality baseline sampling occurs on waters within and near the Palmer property (Figures A6-1a–b). Parameters to be measured and recorded at each station include field parameters, conventional/physical parameters, major cations and anions, total and dissolved metals, and radiochemistry.[1] Laboratory analyses for conventional/physical parameters, major cations/anions, and total/dissolved metals will be conducted by an accredited analytical laboratory. Since 2008, samples have been analyzed by ALS Laboratory Group, Environmental Division (Vancouver, BC, Canada, and

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[1] Radiochemistry was analyzed once at select stations.

Whitehorse, YT, Canada). Radiochemistry analyses were conducted by ALS Laboratory Group, Environmental Division (Fort Collins, CO).

Analytical methods for monitoring and baseline sampling are based on well-established, internationally recognized procedures such as those published by Standard Methods for the Examination of Water and Wastewater (SM), and the U.S. Environmental Protection Agency (EPA). ALS Laboratory Group is a member of the Canadian Association for Laboratory Accreditation Inc. (CALA) and National Environmental Laboratory Accreditation Program (NELAP), which conform to the requirements of ISO/IEC 17025. Documentation of ALS accreditation is provided in Appendix A.

The monitoring schedule is described in Section A.6.2. Data collection parameters, protocol, and reporting requirements are described in Section A.7. Section B.1 provides a description of the sampling process design.

A.6.2 Project Implementation Schedule

Preliminary surface water baseline sampling began in September 2008. Additional surface water baseline sampling following the protocols described in this QAPP is anticipated to continue at the discretion of Constantine. The project implementation schedule is presented in Table A6-1. Implementation of water quality sampling from year to year will depend on the overall status and continuation of the exploration project.

A.7 Data Quality Objectives and Data Measurement Criteria

A.7.1 Data Quality Objectives

Data quality objectives (DQOs) are designed to ensure that the type, quality, and quantity of environmental data used in decision making are appropriate for their intended application. For this QAPP, the following DQOs have been identified to ensure that data of adequate quantity and quality are generated to support the project goals:

> ***DQO 1—Water Quality Monitoring.*** The DQO for water quality monitoring is to ensure that data of sufficient quality for surface, ground, and wastewater are collected in accordance with the Water Management Permit 2019DB0001 .
>
> ***DQO 2—Water Quality Baseline.*** The DQO for water quality baseline sampling is to ensure that data of sufficient quantity and quality are collected to determine typical surface and ground water quality conditions in the absence of significant site disturbance from mineral exploration and related activities. The baseline data may also be used in the future to establish natural-conditions-based site-specific standards for water.

In accordance with the project DQOs, field and laboratory procedures for water quality monitoring have been established to ensure that the quantity and quality of data generated by field and laboratory activities are sufficient to establish a robust baseline data set at an acceptable level of confidence. An overview of the sampling process design is presented in Section B.1; detailed field procedures are described in Sections B.2 and B.3.

State of Alaska regulatory and guidance documents that pertain to the project DQOs include *Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances* (ADEC 2008), 18 AAC 70 *Water Quality Standards* (ADEC 2018), and the *Guidance for the Implementation of Natural Conditions-Based Water Quality Standards (*ADEC 2006).

A.7.2 Measurement Quality Objectives

Measurement quality objectives (MQOs) evaluate and control the data collection process to ensure that measurement uncertainty is within an acceptable range to meet DQOs. MQOs define the acceptable quality of field and laboratory data for the project, in terms of data quality indicators such as the precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters (USEPA 2002a). PARCC parameters are commonly used to assess the quality of environmental data. These parameters, as well as analytical sensitivity (i.e., detectability), will be used to assess conformance of data with quality control criteria.

Project MQOs for field measurements and laboratory analyses are presented in Table A7-1.

Detectability

Detectability is the ability of the analytical method to reliably measure a concentration above background. Two components are used to define detectability: the method detection limit (MDL) and the method reporting limit (MRL).

- The MDL is the minimum value that the instrument can discern above background, but with no certainty to the accuracy of the measured value. For field measurements, the manufacturer's listed instrument detection limit (IDL) can be used. For monitoring data collected under the WMP the MDLs in this QAPP meet or are under the Minimum Level of Quantification as required in Table 5 of the WMP.
- The MRL is the minimum value that can be reported with confidence.

Sample data measured below the MDL are reported as nondetect. Sample data measured ≥MDL but ≤ MRL are reported as estimated data. Sample data measured above the MRL are reported as reliable data unless otherwise qualified per the specific sample analysis. The MRL for both monitoring and baseline data is set at three times the MDL. Any data that fails to produce an MDL below applicable ADEC water quality standards for that analyte will be flagged for not meeting detectability requirements.

Accuracy

Accuracy or bias represents the degree to which a measured concentration conforms to the reference value. The results for matrix spikes, laboratory control samples, field blanks, and method blanks will be reviewed to evaluate bias of the data. The following calculation is used to determine percent recovery for a matrix spike sample:

$$\%R = \frac{M - U}{C} \times 100$$

%R = Percent recovery
M = Measured concentration in the spiked sample
U = Measured concentration in the unspiked sample
C = Concentration of the added spike

The following calculation is used to determine percent recovery for a laboratory control sample or reference material:

$$\%R = \frac{M}{C} \times 100$$

%R = Percent recovery
M = Measured concentration in the reference material
C = Established reference concentration

Results for field and method blanks can reflect systematic bias that results from contamination of samples during collection or analysis. Any analytes detected in field or method blanks will be evaluated as potential indicators of bias.

Precision

Precision reflects the reproducibility between individual measurements of the same property. Precision will be evaluated using the results of matrix spike duplicates, laboratory duplicates, and field replicates. Precision is expressed in terms of the relative standard deviation for three or more measurements and the relative percent difference (RPD) for two measurements. The following equation is used to calculate the RPD between measurements:

$$RPD = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100$$

RPD = Relative percent difference
C_1 = First measurement
C_2 = Second measurement

The relative standard deviation is the ratio of the standard deviation of three or more measurements to the average of the measurements, expressed as a percentage. RPD will be calculated for field and laboratory replicates or duplicates for each sampling event. The RPD goal for this project is 30% (ADEC 2009).

Representativeness

Representativeness is the degree to which data represent a characteristic of an environmental condition. In the field, representativeness will be addressed primarily in the sampling design by the selection of sampling sites and sample collection procedures. In particular, streamflow, channel morphology, and weather conditions will be noted at the time of sampling in order for sample representativeness to be evaluated for each sampling event/location. In the laboratories, representativeness will be ensured by the proper handling and storage of samples and initiation of analysis within holding times.

Comparability

Comparability is the qualitative similarity of one data set to another (i.e., the extent to which different data sets can be combined for use). Comparability will be addressed through the use of field and laboratory methods that are based on methods and procedures recommended by EPA. The data produced under this QAPP will be of sufficient quality for comparison to ADEC water quality standards.

Completeness

Completeness is the comparison between the amount of usable data collected versus the amount of data deemed necessary to define baseline water quality conditions. Completeness will be determined by comparing sampling and analyses completed with the targeted sampling frequency of three events per year, as defined in this QAPP. The overall completeness goal is 85 percent for each sampling event.

A.8 Training and Certifications

Constantine has assembled a project team with the requisite experience and technical skills to successfully complete the Palmer Project. Field sampling will be coordinated by Constantine; all project team personnel involved in sample collection have extensive environmental sampling experience. Minimum training and certification requirements for laboratory personnel are described in the laboratory QA manual (Appendix B of this QAPP). Training requirements specific to this project are specified in Table A8-1. Training documentation will be maintained by the individual service providers.

A.9 Documents and Records

Records will be maintained documenting all activities and data related to sample collection and to laboratory analyses. Results of data verification and validation activities will also be documented. Procedures for documentation of these activities are described in this section. Project documents and records are summarized in Table A9-1 and described below.

A.9.1 Field Documentation

The following field records will be maintained throughout the duration of sampling activities:

- Field logbooks
- Sample collection/measurement forms
- Sample labels
- Sample chain-of-custody (COC) forms
- Custody labels
- Photographic documentation.

A sample matrix table summarizing sampling stations, collection bottles, preservatives, and analysis methods will be maintained to guide field collection activities. Field documentation related to sample collection will be maintained by the field coordinator in a designated project file. The laboratory will return completed COC forms to the project manager (or designee) with the data packets; these forms will also be maintained in the project file. An example sample matrix table and COC form are provided in Appendix C. The project manager will ensure that the field coordinator receives the QAPP prior to the initiation of field activities.

A.9.2 Laboratory Documentation

All activities and results related to sample analysis will be documented at the analytical laboratory. Internal laboratory documentation procedures are described in the laboratory QA manual (Appendix B of this QAPP).

The analytical laboratory will provide a data package for each sample delivery group or analysis batch. Each data package will contain all information required for a completed QA review, including the following:

- A cover letter discussing analytical procedures and any difficulties that were encountered
- A case narrative referencing or describing the procedures used and discussing any analytical problems and deviations from SOPs and this QAPP
- COC and cooler receipt forms
- A summary of analyte concentrations (to two significant figures, unless otherwise justified), MRLs, and MDLs
- Laboratory data qualifier codes appended to analyte concentrations, as appropriate, and a summary of code definitions
- Sample preparation logs.

Data will be delivered in electronic format to the QA manager. The final repository for all sample information will be an electronic client database.

A.9.3 Raw Data

Laboratory data will be maintained by each laboratory for a period of at least 5 years. These data will include the original instrument data files, reduced and verified data stored in the laboratory information management system (LIMS), and final hard-copy and electronic data deliverables. The laboratory will obtain approval from Constantine prior to discarding these data.

A.9.4 Quality Assurance

Data validation reports will be prepared and provided to the QA manager. Results of the validation reports and any limitations to the usability of the data will be summarized in the project summary data report for each sampling event.

All changes to the data set will be documented in an electronic log file that automatically enters a current time stamp when opened and allows the data editor to enter notes about changes to the database. Any data tables prepared from the database for data users will include all qualifiers that were applied by the laboratories and during data validation, unless otherwise requested.

The QA manager will maintain QA documentation throughout the duration of sampling. The following laboratory QA documentation is included in each laboratory data package:

- Instrument tuning check data
- Initial and continuing calibration data, including instrument printouts and quantification summaries, for all analytes
- Results for method and calibration blanks
- Results for all QA/QC checks, including, but not limited to, internal standards, laboratory control samples, matrix spike samples, matrix spike duplicate samples, and laboratory duplicate or triplicate samples provided on summary forms
- Instrument data quantification reports for all analyses and samples
- Copies of all laboratory worksheets and standards preparation logs.

As discussed above, laboratory QA data will be delivered in electronic format to the QA manager, who will be responsible for oversight of data verification and validation and for archiving the final data and data quality reports in the project file. Laboratory QA data will be maintained by each laboratory for a period of at least 5 years. The laboratory will obtain approval from the project manager prior to discarding these data.

The following reports will be completed, as necessary, to document deviation from the QAPP:

- Corrective action reports will be used, as necessary, to document any problems encountered during field activities and corrective actions taken
- Field change request forms will be used, as necessary, to document the need for a procedural change or a station location change
- System and performance audit reports will be used, as necessary, to document review or audit of field sampling activities.

A.9.5 Data Summary Reports

The baseline monitoring covered by this QAPP is conducted voluntarily and is not regulated under a state or federal permit. Project data summary reports will be completed at the discretion of the Constantine Project Manager for purposes of evaluating data quality and baseline water quality conditions. Data summary reports may include an overview of sampling activities, data quality, changes to the monitoring plan, water quality observations, trends and patterns, and comparison to water quality criteria.

B. DATA GENERATION AND ACQUISTION

B.1 Sampling Process Design

Sampling may be conducted at stations within and near to the Palmer property including surface, ground, and wastewater stations documented in the WMP. Monitoring sampling events will be conducted on a quarterly basis as the WMP requires when water is flowing and samples can be safely collected. Baseline sampling events will be timed to evaluate key flow conditions for the site: low or flushing flows in the spring, summer typical flows, the fall rainy season, and winter base flow. Sampling these seasonal periods is intended to capture data from flow regimes that best characterize the range of possible site conditions. Note that, due to the remoteness of the monitoring stations and safety and accessibility challenges, these target monitoring time frames may not always be attainable. Implementation of water quality sampling from year to year will depend on environmental conditions, monitoring data gaps, and the status of the exploration project.

B.1.1 Monitoring Objectives

The key monitoring objective is to monitor surface, ground and wastewater quality for potential effects from project activities and to ensure that water quality standards or natural conditions are protected and based on representative samples as required by the WMP. The second monitoring monitoring objective is to continue to establish a baseline water quality data set. Baseline water quality data will be used to characterize water quality typical of the Palmer Project area prior to mine development. Baseline data will define natural conditions for the area and may be used in the future to establish natural-conditions-based water quality criteria. This QAPP and the DQOs specified in Section A.7 support the monitoring objective by ensuring that data is of sufficient quality to define baseline water quality conditions.

B.1.3 Monitoring Parameters and Program

Parameters required for monitoring are referenced in the WMP Table 5 and in Tables A6-1 and A7-1. For monitoring requirements parameters will be tested for total recoverable concentrations. Parameters to be measured and recorded at each station for baseline monitoring are listed in Tables A6-1 and A7-1 and include field parameters (temperature, specific conductance, dissolved oxygen, pH, and turbidity), conventional/physical parameters (total dissolved solids [TDS], total suspended solids [TSS], hardness, and acidity), major cations and anions (alkalinity, bromide, chloride, fluoride, ammonia, nitrate/nitrite complex, sulfate), and 33 total and dissolved metals. Radiochemistry (gross alpha, radium-226) was measured at select stations during at one baseline sampling event in 2017. Total cyanide may be included in the analysis at the discretion of Constantine; this parameter is included here for completeness. Both sampling programs will measure field parameters *in situ*.Analysis of all other conventional/physical parameters, major cations/anions, and total/dissolved metals will be conducted by an accredited analytical laboratory. To date, analysis has been conducted by ALS (Vancouver, BC, Canada; Whitehorse, YT, Canada; and Fort Collins, CO). Analytical methods are based on well-established, internationally recognized procedures, such as those published by SM and EPA. ALS is a member of CALA, which conforms to the general requirements for the competence of testing and calibration laboratories (ISO/IEC 17025).

B.2. Sampling Methods

Procedures for collection, preservation, and handling of water samples are specified in the following sections.

B.2.1 Sample Types

Samples will be listed as “grab” (for surface water grab samples collected for submittal to the analytical laboratory) or “in situ” (for field parameters monitored directly in the stream) on the COC form, in the field data sheets, and in the field logbook.

Groundwater samples will be listed as “well” (for groundwater samples collected from wells or other groundwater expressions for submittal to the analytical laboratory) or “in situ” (for field parameters monitored directly from the well or groundwater expression) on the COC form, in the field data sheets, and in the field logbook.

B.2.2 Sample Containers and Equipment

All sampling equipment and sample containers will be cleaned according to the equipment specifications and/or the analytical laboratory specifications. Sample containers will be supplied by the laboratories. Commercially available pre-cleaned containers will be used, and each laboratory will maintain a record of certification from the suppliers. Prior to shipment to the field, the project laboratories will add the required preservatives to the sample bottles and supply additional preservative in a transportable container. Alternatively, the project laboratory may provide preservative in separate individual vials for addition to the sample bottle at the time of sampling. Sample containers, sample size requirements, preservation, and holding times for surface water samples are summarized in Table B2-1.

B.2.3 Sampling Methods

B.2.3.1 Surface Water Grab Samples

All surface water samples will be collected as grab (not composite) samples from streams and creeks. Samples will be collected in flowing water (away from eddies and interferences) as close to mid-channel as is safely possible, and will be collected at a depth of approximately 6 inches below the water surface. Each sample bottle will be filled individually directly from the stream. During low flow conditions, the sampler may use the peristaltic pump to fill all sample bottles and avoid disturbance of stream bed sediment materials. If a peristaltic pump is used, the pump inlet will be placed in the flowing water portion of the stream and elevated as needed to avoid uptake of stream bed sediments. The sample container will be held near the pump outlet and then filled.

For filtered samples, the field sampler will use laboratory-supplied 0.45-µm filters and syringes. The sampler will field rinse the filter by rinsing with 50 mL of DI water and then draw sample water into the syringe from the collection bottle, screw the filter onto the syringe, and flush the filter with at least 10 to 20 mL of sample water depending on the size of the bottle (Skrobialowski 2016) . Begin filling the sample container by successively (if needed) filling the syringe and forcing sample through the filter directly into the sample bottle. Alternatively, filtered surface water samples may be collected using a peristaltic pump and an in-line 0.45-µm filter placed at the tubing outlet to filter samples immediately before the water is discharged into the sample bottle. In this case, the filter will be field rinsed with 2 liters of DI water and conditioned with 25 to 50 mL of field sample depending on the bottle size.

Samples being collected for the quarterly requirement of the WMP will not require filtered samples as all required analytes are in total recoverable concentrations.

Grab sampling SOPs are presented in Appendix D.

B.2.3.2 Groundwater Samples

Groundwater samples may be collected from two types of sample locations: 1) free-flowing groundwater that expresses from drilled holes or natural features such as seeps and springs; or 2) from installed monitoring wells. Sample will be collected from each of these types of locations as follows:

- Free-flowing groundwater: Samples will be collected as grab (not composite) samples, following the procedures for surface water grab samples described above and in Appendix D. Because the expressed water from holes or natural features is free flowing and the sampling location is not a monitoring well, well purging is not required prior to sample collection. Free-flowing groundwater will be collected directly into sample bottles as grabs from the groundwater discharge stream. During low flow conditions, the sampler may use the peristaltic pump to fill all sample bottles and avoid disturbance of stream bed sediment materials so as not to collect sediments or soils. The collection container will then be used to fill individual sample bottles to the bottle collar.
- Groundwater monitoring wells: Samples will be collected following the monitoring well purging and groundwater well sampling methods described in Appendix D, using a submersible Grundfos or similarpump and high- or low-density polyethylene tubing. Monitoring wells will be purged using the EPA low-flow method before groundwater samples are collected for analyses. Field parameters (e.g., pH, temperature, specific conductance, redox potential, dissolved oxygen, and turbidity) will be measured during the purging process in 3 to 5 mintute intervals using a flow through cell to verify that groundwater conditions are stable based on the stabilization criteria provided in Appendix D prior to sampling to ensure a representative groundwater sample is collected. The low-flow purging method minimizes stress (drawdown) to the system while still removing water that is not representative of the formation. While purging, the water level will be checked to check that the pump flow rate does not exceed the recharge rate of the well. In the event that even very low purge rates result in evacuation of the well, groundwater samples for laboratory analyses will be collected as soon as sufficient groundwater accumulates in the well, regardless of the stabilization of field parameters. Tubing will be replaced between wells. The submersible pump will be decontaminated between wells by scrubbing with an Alconox solution, followed by rinses of tap water and deionized water, respectively.

Filtered groundwater samples, collected from either free-flowing groundwater or from montoring wells, will be collected using either a pump and in-line filter or a syringe filter, following the procedures described in Appendix D. In either case, laboratory-supplied 0.45-µm filters will be used. For the pump method, the pump inlet will be placed in the screened portion of the well so as not to uptake any sediments at the bottom. The sample container will be held near the pump outlet and filled being sure not to overfill pre-preserved containers. The sample containers will be capped, labeled, and placed inside a cooler. For filtered samples, a 0.45-µm filter will be placed in-line to filter samples immediately before the water is discharged into the sample bottle. For syringe filters, the sampler will fill a collection bottle and then draw the sample into the syringe from the collection bottle, screw the filter onto the syringe, and flush the filter with sample water. The sample bottle will be filled by (successively, if needed) filling the syringe and forcing sample through the filter directly into the sample bottle.

Samples being collected for the quarterly requirement of the WMP will not require filtered samples as all required analytes are in total recoverable concentrations.

B.2.3.3 Wastewater Samples

Wastewater samples will be collected as grab (not composite) from the pipe connecting the settling ponds and the lower diffuser. Samples will be collected from a valve in the pipe. Each sample bottle will be filled individually directy from the valve being sure to not overfill each bottle.

There is no filtration required for the wastewater samples as all required analytes are in total recoverable concentrations.

B.2.3.4In Situ Samples

In situ measurements of general water quality characteristics will be taken at all sampling stations, including conductivity, redox potential, dissolved oxygen, pH, temperature, and turbidity.[2] Either multi-parameter (multiprobe) or individual parameter probes may be used for dissolved oxygen, pH, temperature, and conductivity measurements. A turbidity meter will be used for turbidity measurements. All field instruments must meet the method requirements listed in Table A7-1. For surface water samples, if the conditions are safe and if water at the sampling location is deep enough to adequately submerge the probe, the probe will be placed directly in the stream. (If conditions are unsafe or if water is too shallow, a peristaltic pump may be used to supply a continuous flow of water to a clean, non-reactive container, and the probe placed in the container.) Measurements will be recorded when the field instrumentation readings have stabilized. Field instruments will be maintained, cleaned, and calibrated with standard reference solutions per the manufacturer's specifications. *In situ* field measurement SOPs are presented in Appendix D. Field forms and calibration log forms are included in Appendix E.

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[2] Due to natural site conditions, highly turbid samples may exceed the measurement capability of field measurement probes. If turbidity measurements do not fall within the calibrated range of the field instrument, dilutions should be performed in the field to obtain accurate measurements. A turbidity dilution SOP is included in Appendix D.

B.3 Sample Handling and Custody

Detailed descriptions of procedures for sample identification, handling, documentation, custody, and ultimate disposal are presented in the following sections.

B.3.1 Sampling Procedures

Sampling methods and procedures are described in Section B.2 and in Table B2-1.

B.3.2 Sample Custody Procedures

From the time of collection, all samples will be stored on ice or refrigerated at an approximate temperature of 4°C ± 2°C .

The field coordinator, or the designated field sample custodian, will be responsible for sample tracking in the field. Samples will remain in the field coordinator or their desginee's custody until COC forms and final sample inventory are completed in the field or at the field sample processing facility. COC forms will be used for samples that are in transit from the field site to the analytical laboratory. The custodian will relinquish the samples prior to shipping to the analytical laboratory.

Samples are considered to be in custody if they are 1) in the custodian's possession or view, 2) in a secured location (under lock) with restricted access, or 3) in a container that is secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s). The principal documents used to identify samples and to document possession are COC records, field logbooks, and field tracking forms. COC procedures will be used for all samples at all stages in the analytical or transfer process and for all data and data documentation whether in hard-copy or electronic format. An example of a COC form is provided in Appendix C.

B.3.3 Sample Shipping

Samples will be shipped to the laboratory in ice chests sealed with custody seals. Each ice chest will have three seals, one on the front of the chest and one on each side. The laboratory sample custodian will establish the integrity of the seals at the laboratory. If samples are shipped via a shipping or cargo service, the way bill of the carrier used to ship samples will provide additional custody and sample tracking information. The way bills will be maintained in the project file.

The sample custodian at the laboratory will accept custody and log samples into the LIMS. The sample custodian will check that the COC forms were properly completed and signed, that a sample receipt form is completed for each cooler, and that samples are stored under the required temperature conditions. The laboratory will deliver a copy of the COC and sample receipt form to the QA manager. Any breaks in the COC or non-conformances will be noted and reported in writing to the QA manager within 24 hours of receipt of samples. Specific laboratory COC procedures are described in the laboratory QA manual (Appendix B).

The laboratory project manager will ensure that a sample-tracking record is maintained that follows each sample through all stages of laboratory processing. The sample-tracking record must contain, at a minimum, the names of individuals responsible for performing the analysis; dates of sample extraction, preparation, and analysis; and the type of analysis being performed.

Any sample needing further analysis that is not performed by the initial contracted laboratory will be subject to all custody specifications provided in the previous section.

B.4 Analytical Methods and Requirements

All samples will be shipped to an accredited analytical laboratory. To date, all project samples have been sent to ALS. ALS (Whitehorse, YT, Canada) receives the samples and will perform the analyses for select cation/anion parameters with short sample hold time requirements (chloride, fluoride, nitrate as N, nitrite as N, and sulfate). ALS Whitehorse will transfer the samples to ALS Vancouver for additional cation/anion analyses, conventional analyses, and total/dissolved metals analyses except for nitrate/nitrite complex analysis which will be transferred to ALS Kelso. As needed, sample aliquots will be sent to ALS (Fort Collins, CO) for radiochemistry analysis (one sample event only). Laboratory methods to be used for the Palmer Project are based on SM and EPA methods, and follow CALA accreditation (Appendix A). The laboratory methods for sample preparation and analysis are summarized in Table A7-1.

B.4.1 Conventional Analyses

Conventional analyses will include hardness as $CaCO_3$, TDS, acidity, weak acid dissociable (WAD) cyanide, and TSS. ALS uses methods based on the SM methods shown in Table A7-1.

Hardness as $CaCO_3$ and TDS will be determined arithmetically according to SM 2340B (SM 1997) and SM 1030E, respectively. TSS will be determined gravimetrically according to SM 2540D (SM 1997). WAD cyanide will be determined colorimetrocally according to SM 4500-CN (SM 1997).

B.4.2 Cations/Anions

Alkalinity as $CaCO_3$ will be determined titrimetrically according to SM 2310B (SM 1997). Bromide, chloride, fluoride, nitrate as N, nitrite as N, and sulfate will be determined by ion chromatography according to EPA Method 300.1 (USEPA 1997). Nitrate as N is a required analyte of the Waste Management Permit 2019DB0001. Ammonia will be determined using fluorescence detection (Watson et al. 2005). Nitrate/nitrite complex will be determined by automated colorimetry according to EPA Method 352.3 (USEPA 1993). Nitrate as N and nitrite as N have 48 hour hold times based on EPA method 300.1. Due to the remoteness of where the samples are collected and the effort it takes to get the samples to the lab for analysis, it is likely that these samples will consistently be over the 48 hour hold time.

Dissolved organic carbon (DOC) is being added to the list of parameters beginning with the September 2019 QAPP update. DOC will be determined according to APHA 5310B methodology (APHA, 2017).

B.4.3 Total/Dissolved Metals

Four methods will be used to analyze samples for total and dissolved metals (Table A7-1). Digestion with nitric acid will be used to prepare samples for analysis of metals other than mercury and phosphorus. Analysis for metals other than mercury and phosphorus will be completed by inductively coupled plasma/mass spectrometry and inductively coupled plasma/optical emission spectrometry, according to EPA Methods 6020A and 200.2, respectively (USEPA 2007, 1994).

Mercury samples will be oxidized using bromochloride (BrCl) and then reduced to volatile elemental mercury using stannous chloride ($SnCl_2$). Analyses will be completed by cold vapor atomic fluorescence spectrometry, according to EPA Method 1631E (USEPA 2002c).

Total and dissolved phosphorus analyses will be determined by ascorbic acid colorimetric procedures adapted from EPA 200.2/6020A (1994, 2007). Total phosphorous is determined after an additional persulfate digestion of the sample. Dissolved phosphorous is determined by filtering a sample through a 0.45-micron membrane filter followed by persulfate digestion of the filtrate.

B.4.4 Radiochemistry

Radiochemistry analysis was conducted for only one sampling event in the baseline monitoring program at select sites in 2017. Samples were analyzed for gross alpha based on EPA Method 900.0 (USEPA 1980a) (Table A7-1). An aliquot of the sample will be evaporated to a small volume and quantitatively transferred to a counting planchet; the sample residue is dried to constant weight and counted for alpha radioactivity. radium-226was analyzed according to EPA Methods 903.1 (USEPA 1980b) (Table A7-1). Radium-226 was determined according by concentrating an aliquot of the sample and separating it by coprecipitation on barium sulfate; the precipitate is dissolved in ethylenediaminetetraacetic acid (EDTA) reagent and placed in a scintillation cell with radon-222 gas, where it is counted for alpha activity.

B.5 Quality Control Requirements

Quality control (QC) samples will be prepared in the field and at the laboratories to monitor the bias and precision of the sample collection and analysis procedures.

B.5.1 Field Quality Control Measures

Implementation of proper field QC measures limits uncertainty in sample results. Field QC measures include proper cleaning of sample containers and sampling equipment, use of uncontaminated and unexpired chemical reagents and standard reference solutions, correct sample labeling, proper sample handling and transport, and replicate measurements. Field QC measures also involve proper maintenance, cleaning, and calibration of field monitoring equipment with standard reference solutions per the manufacturer’s specifications. Additional field QC measures include collection of field replicate, field duplicate, and field blank samples. As used in this QAPP, the term *field replicate* refers to separate samples or measurements identically collected as close as possible to the same point in space and time as the original sample(s). *Field duplicate* samples are collected from a single thoroughly homogenized sample that is split between an original and duplicate sample. Field blank samples are deionized water samples prepared prior to sampling and carried to the sample site to detect contamination during sample handling or analysis.

Field QC samples for this project will include field replicates and field blanks. A summary of field QC samples that may be collected for each sampling event is provided below and presented in Table B5-1.

Field replicates are samples collected at the same station, but using different deployments of the sampling equipment. The data for field replicates are used to evaluate variability at the sampling site. One field replicate will be collected for every 10 samples collected for each sampling event. A sampling event is defined as an event that is completed over consecutive days that may include groundwater and surfacewater samples. Field replicates will be collected at different sample locations for each sample event.

A field blank (a set of sample collection bottles filled with laboratory distilled/deionized water exposed to sampling conditions by opening the bottles and preserved with the appropriate preservative) is included with each sampling event. This blank is used to check for analytical artficats and/or background introduced by sampling and analytical procedures.

B.5.2 Laboratory Quality Control

Extensive and detailed requirements for laboratory QC procedures are provided in the method protocols that will be used for this study (Table A7-1). Every method protocol includes descriptions of QC procedures, and many incorporate additional QC requirements by reference to separate QC chapters. QC requirements include control limits and, in many cases, requirements for corrective action. QC procedures will be completed by the laboratories, as required in each method protocol and as indicated in this QAPP.

The frequency of analysis for laboratory control samples, matrix spike samples, matrix spike duplicates or laboratory duplicates, and method blanks will be one for every 20 samples, or one per extraction batch, whichever is more frequent. Calibration procedures will be completed at the frequency specified in each method description. Control limits specified in the method descriptions will be used by the laboratories to establish the acceptability of the data or the need for reanalysis of the samples. Control limits for precision and accuracy are provided in Table A7-1.

Where discrepancies exist between this QAPP and laboratory SOPs and QA manuals, this QAPP will take precedence.

B.6 Instrument/Equipment Testing, Inspection, and Maintenance

Analytical instrument testing, inspection, maintenance, setup, and calibration will be conducted by each laboratory in accordance with the requirements identified in the laboratory SOPs and manufacturer instructions. Instrument maintenance and repair will be documented in maintenance logs or record books. ALS Laboratories maintains analytical instrument performance check and maintenance records, as described in Appendix B.

Field instrument testing will be conducted by field staff. Prior to each sampling event, all sampling instruments and equipment will be tested and inspected in accordance to manufacturers’ specifications. All calibration solutions, cleaning solutions, preservatives, or other chemicals will be inspected to ensure that expiration dates have not been exceeded.

B.7 Instrument/Equipment Calibration and Frequency

Field instruments must meet the project-specific requirements described in this QAPP and the MQOs listed in Table A7-1. Instruments will be calibrated prior to each field event following the instructions in the SOPs in Appendix D. If instruments are rented from a third-party supplier, they may be pre-calibrated with reference solutions per the manufacturer’s specifications before use in the field. Daily calibration checks will be performed according to SOPs (Appendix D) and in conjunction with the operating manuals supplied by the manufacturers. Daily calibration check results will be recorded in calibration log forms (Appendix E). Field instruments calibration checks will be performed at the beginning of each field collection day and at intermediate times during the day as deemed necessary by the field sample collector. All calibration tests will be documented in the calibration log form (Appendix E).

Laboratory instruments will be properly calibrated, and the calibration will be verified with appropriate check standards and calibration blanks for each parameter before beginning each analysis. Instrument calibration procedures and schedules will conform to analytical protocol requirements and descriptions provided in the laboratories' SOPs and QA manuals, as described in Appendices A and B.

All calibration standards will be obtained from either the EPA repository or a commercial vendor, and the laboratory will maintain traceability to the National Institute of Standards and Technology. Stock standards will be used to make intermediate standards and calibration standards. Special attention will be given to expiration dating, proper labeling, proper refrigeration, and prevention of contamination. Documentation relating to the receipt, mixing, and use of standards will be recorded in a laboratory logbook. All calibration and spiking standards will be checked against standards from another source.

B.8 Inspection/Acceptance of Supplies and Consumables

The quality of supplies and consumables used during sample collection and laboratory analysis can affect the quality of the project data. All equipment that comes into contact with the samples and extracts must be sufficiently clean to prevent detectable contamination, and the analyte concentrations must be accurate in all standards used for calibration and QC purposes. Safety data sheets for consumable chemicals used for cleaning and sample preservation are provided in Appendix F.

All shipments of sampling bottles, reagents, solvents, or other sampling materials received from laboratories or other suppliers will be inspected upon receipt for completeness, purity, expiration dates, signs of leakage or damage, discoloration, or other indicators of possible QC issues. Chemicals will be checked for expiration date, sufficient quantity and discoloration. No standard solutions, buffers, or other chemical additives will be used if the expiration date has passed. Field staff will document and verify the inspection/acceptance of supplies and consumables in logbooks.

During sample collection, solvents of appropriate, documented purity will be used for decontamination. Solvent containers will be dated and initialed when they are opened. The quality of laboratory water used for decontamination will be documented at the laboratory that provides the water. Cleaned and documented sample containers will be provided by the laboratory. All containers will be visually inspected prior to use, and any suspect containers will be discarded.

Reagents of appropriate purity and suitably cleaned laboratory equipment will also be used for all stages of laboratory analyses. Details for acceptance requirements for supplies and consumables at the laboratories are provided in the laboratory SOPs and QA manuals (Appendices A and B). All supplies will be obtained from reputable suppliers with appropriate documentation or certification. Supplies will be inspected to confirm that they meet use requirements, and certification records will be retained by the project manager, or designee, (i.e., for supplies used in the field) or the laboratories.

B.9 Data Acquisition Requirements (Nondirect Measurements)

No nondirect data collection is required at this time.

B.10 Data Management

Data for this project will be generated in the field and at the laboratories. Analytical results are sent directly from the laboratory to the final repository for all sample information, which will be a client database maintained by a qualified contractor. Procedures to be used to transfer data from the point of generation to the database are described in this section and shown in Figure B10-1.

B.10.1 Field Data

Field records (a combination of field logbooks and field data sheets) will make up the main documentation for field activities. The records and procedures most applicable to field activities are summarized in field logbooks and field data sheets. Examples of field data sheets are presented in Appendix E.

Data that are generated during sample collection and sample preparation will be manually entered into the field logbook and field data sheets. Data from these sources will be entered into an electronic format directly from the field logbook. These data include *in situ* field measurements, station location coordinates, station names, sampling dates, sample identification codes, and additional station and sample information including unusual conditions and explanation of data anomalies (e.g., water depth, sample type). A second individual will review all entries for accuracy and completeness, and any errors will be corrected before the data are uploaded to the database and approved for release to data users.

B.10.2 Laboratory Data

A wide variety of manually entered and electronic instrument data are generated at the laboratories. Data are manually entered into:

- Standard logbooks
- Storage temperature logs
- Balance calibration logs
- Instrument logs
- Sample preparation and analysis worksheets
- Maintenance logs
- Individual laboratory notebooks
- Results tables for conventional analyses.

The LIMS is the central data management tool for each laboratory. All manual data entry into the LIMS is proofed at the laboratory. All data collected from each laboratory instrument, either manually or electronically, are reviewed and confirmed by analysts before reporting. The LIMS is used for every aspect of sample processing, including sample log-in and tracking, instrument data storage and processing, generation of data reports for sample and QC results, and preparation of electronic data deliverables (EDDs).

Laboratory data will be entered directly into the client database from the EDD.

B.10.3 Data Storage and Retention

Data management files generated by the data management contractor will be stored on a secure computer or on a removable hard drive that can be secured. Laboratory records will be retained by the contract laboratory for a minimum of 5 years. Project records will be retained by Constantine for a minimum of 5 years.

C. ASSESSMENT AND OVERSIGHT

C.1 Assessments and Response Actions

C.1.1 Readiness Reviews

Readiness reviews are conducted to ensure that all necessary preparations have been made for efficient and effective completion of each critical phase of project work. Field readiness reviews will be conducted prior to initiation of each field sampling event. The field coordinator will verify that all field equipment is ready for transfer to the site. Any deficiencies noted during this readiness review will be corrected prior to initiation of sampling activities.

A readiness review will also be completed before final data are released for use. The data manager will verify that all results have been received from the laboratory, data validation and data quality assessment have been completed for all of the data, and data qualifiers have been entered into the database and verified. Any deficiencies noted during this review will be corrected by the data manager, the QA manager, or their designee. Data will not be released for final use until all data have been verified and validated. No report will be prepared in conjunction with the readiness reviews. However, the project manager and data users will be notified when the data are ready for use.

C.1.2 Field Procedures Inspection

The Constantine Project Manager may designate a third party to conduct an onsite review of field monitoring operations for compliance with QAPP requirements and SOPs. Additional field procedures inspections may be initiated at the discretion of the Constantine Project Manager and may be requested by the project QA Officer. The auditor will submit a field audit report to the project manager, QA Officer, and Field Coordinator. Any revisions to field procedures will be documented.

C.1.3 Work Product Reviews

Technical review of intermediate and final work products generated for this project will be completed throughout the course of all sample collection, laboratory analysis, data validation, and data management activities to ensure that every phase of work is accurate and complete and follows the QA procedures outlined in this QAPP. Any problems that are encountered will be resolved between the reviewer and the person completing the work. Any problems that cannot be easily resolved or that affect the final quality of the work product will be brought to the attention of the project managers.

C.1.4 Analytical Laboratory Reviews

The laboratories have implemented a review system that serves as a formal surveillance mechanism for all laboratory activities. The analyst initially verifies the accuracy of the data and conformance of calibrations and QC results to control limits. A second review of sample, calibration, and QC results is conducted by the section supervisor, a senior chemist, or other qualified personnel, as designated by the laboratory. Details are provided in the laboratory QA manual (Appendix B).

ADEC requires Discharge Monitoring Report Quality Assurance (DMRQA) blind proficiency testing for NPDES/APDES permits. Laboratories may use reporting data from annual water pollution studies administered by an accredited proficiency test provider to satisfy DMRQA study requirements. At Constantine's request, ALS participated in DMRQA proficiency testing for 2011 (DMRQA Study 31). The results are included in Appendix A.

Any project team member who discovers or suspects a non-conformance is responsible for reporting the non-conformance to the project manager or the QA manager, as applicable. The project manager will ensure that no additional work dependent on the non-conforming activity is completed until a confirmed non-conformance is corrected.

When a non-conformance is identified, a corrective action plan will be prepared. The plan will include identifying the corrective action, the person or organization responsible for implementing the corrective action, and procedures for confirming that the desired results are produced. The corrective measures will be appropriate to the severity of the non-conformance and realistic in terms of the resources required for implementation.

C.2 QAPP Revisions

This QAPP may be reviewed and revised. Minor revisions such as changes to project staff may be made without formal comment. Revisions to the QAPP that may influence DQOs, MQOs, data validation, or monitoring methods will be submitted to the Project Management and ADEC.

C.3 Reports

Table C3-1 describes assessment types, frequency, content, responsible individual(s), and distribution of assessment reports to management and other recipients and actions to be taken.

D. DATA VALIDATION AND USABILITY

Data generated in the field and at the laboratories will be verified and validated according to criteria and procedures described in this section. Data quality and usability will be evaluated and reported to Constantine.

D.1 Data Review, Validation, and Verification Requirements

Field and laboratory data for this project will undergo a formal verification and validation process under the direction of the QA Manager. All manual entries into the database will be verified. All errors found during the verification of field data, laboratory data, and the database will be corrected prior to release of the final data.

D.2 Validation and Verification Methods

Data validation and verification is designed to ensure that reported values meet the quality goals of the project and for its intended use. The purpose of data validation is to detect and verfiy any data values that may not represent actual surface, ground, and wastewater conditions at each sampling station. Data validation also attempts to give reasons for sampling and analysis anomalies, and the effect that these anomalies have on the overall value of the data.

D.2.1 *In Situ* Data

Field data will be verified during preparation of samples and COCs. Field data and COCs will be reviewed on a daily basis by the field coordinator. After field data are entered into the project database, 100 percent verification of the entries will be completed to ensure the accuracy and completeness of the database. Any discrepancies will be resolved before the final database is released for use.

D.2.2 Laboratory Analytical Data

All laboratory data will be validated according to the laboratory's QA Manual and SOPs and as specified in this QAPP. Data verification and validation will be conducted in accordance with *Guidance on Environmental Data Verification and Validation* (USEPA 2002a). Data verification and validation for conventional and inorganic analyses will be completed according to methods described in the EPA guidance for data review (USEPA 2002b). Performance-based control limits established by the laboratory and control limits provided in the method protocols will be used to evaluate data quality and determine the need for data qualification. Laboratory control limits for precision and accuracy are provided in Table A7-1 and will be used for data validation. For each laboratory package, the project QA officer will fill in the ADEC Laboratory Data Review Checklist as additional documentation of QA procedures and results.

Results for field replicates will be evaluated against RPD goal of 30% (ADEC 2009). Data will not be qualified as estimated if this control limit is exceeded, but RPD results will be tabulated, and any exceedances will be noted. Field blanks will be evaluated and data qualifiers will be applied in the same manner as method blanks, as described in the applicable EPA guidance documents for data review (USEPA 2002a,b).

Data will be flagged if control limits for acceptance of data are not met, as described in USEPA (2002a,b). Additionally, any data that fails to produce an MDL below applicable ADEC water quality standards for that analyte will be flagged for not meeting detectability requirements.

Rationale for errors and anomalies found during the QA/QC of the laboratory data will be provided to the QA Officer with the data results. D.2.3 Project Database

In addition to verification of field and laboratory data and information, 100 percent of the data qualifier entries into the database will be verified. Any discrepancies will be resolved before the final database is released for use. The accuracy and completeness of the database will be verified at the laboratory and again as part of data validation. Data flags from the validation and verification process will be maintained in the final database as documentation for data users.

D.3 Reconciliation with User Requirements

The goal of data validation is to determine the quality of each data point and to identify data points that do not meet the project criteria. Non-conforming data may be qualified as undetected, estimated, or rejected as unusable during data validation if criteria for data quality are not met. Rejected data will not be used for any purpose.

Data qualified as estimated will be used for all intended purposes and will be appropriately qualified in the final project database. These data may be less precise or less accurate than unqualified data. The data users will evaluate the effect of the inaccuracy or imprecision of the qualified data.

The measure of usability for this data is that it meets the DQOs and MQOs defined in this QAPP and it meets the scientific and statistical evaluation to determine it is the right type, quality, and quantifty to support its use in this project. In the event that project objectives are not met, data will be flagged, the Project QA Officer will address issues immediately, and sampling or analysis methods may be modified.

E. REFERENCES

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Figures

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HDR

CONSTANTINE metal resources ltd.

🟦 Property Boundary

0 10 20
Miles

N

Basemap Source:
National Geographic World Map

Figure A5-1.
Property Location Map
Palmer Project

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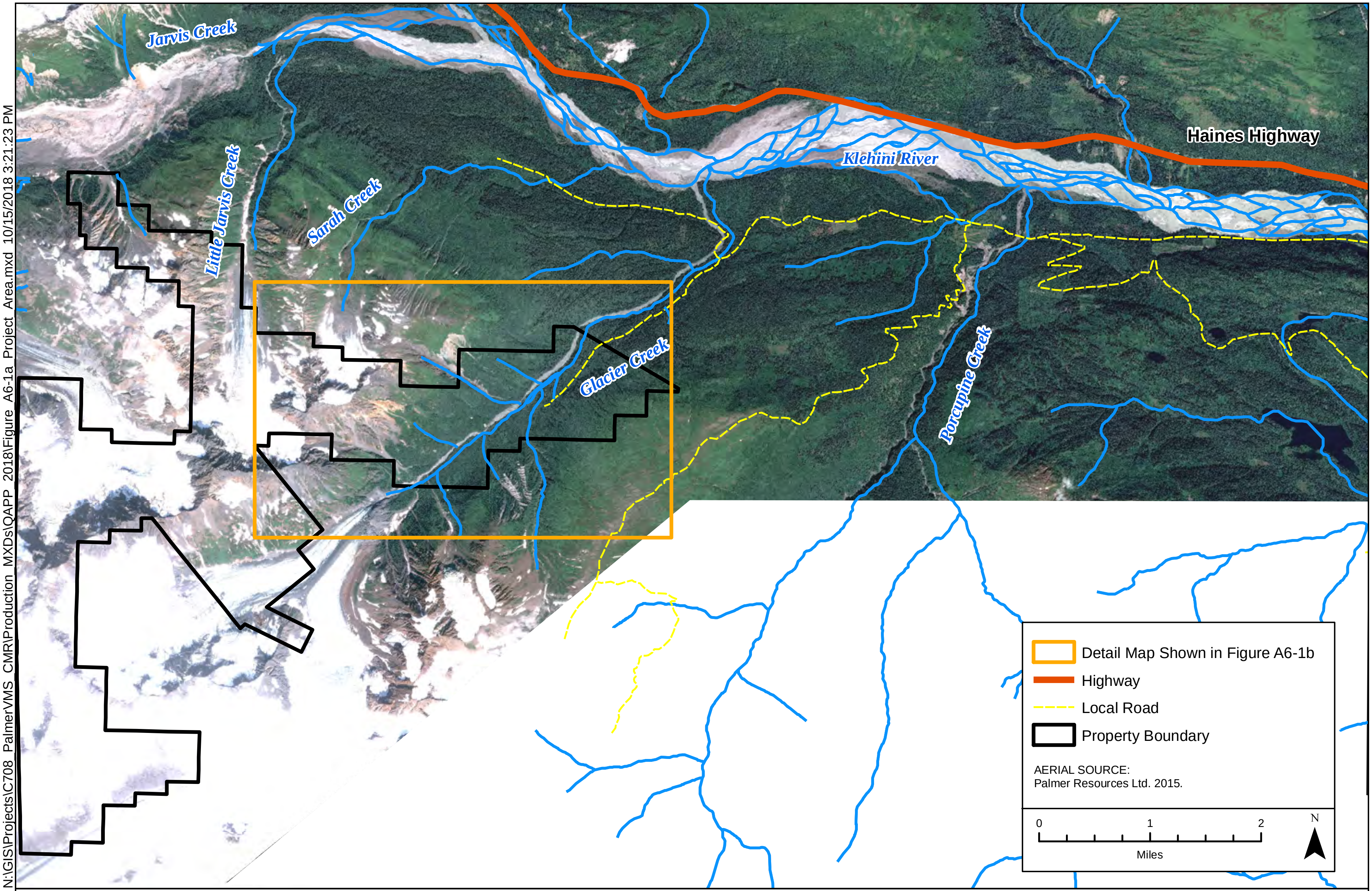
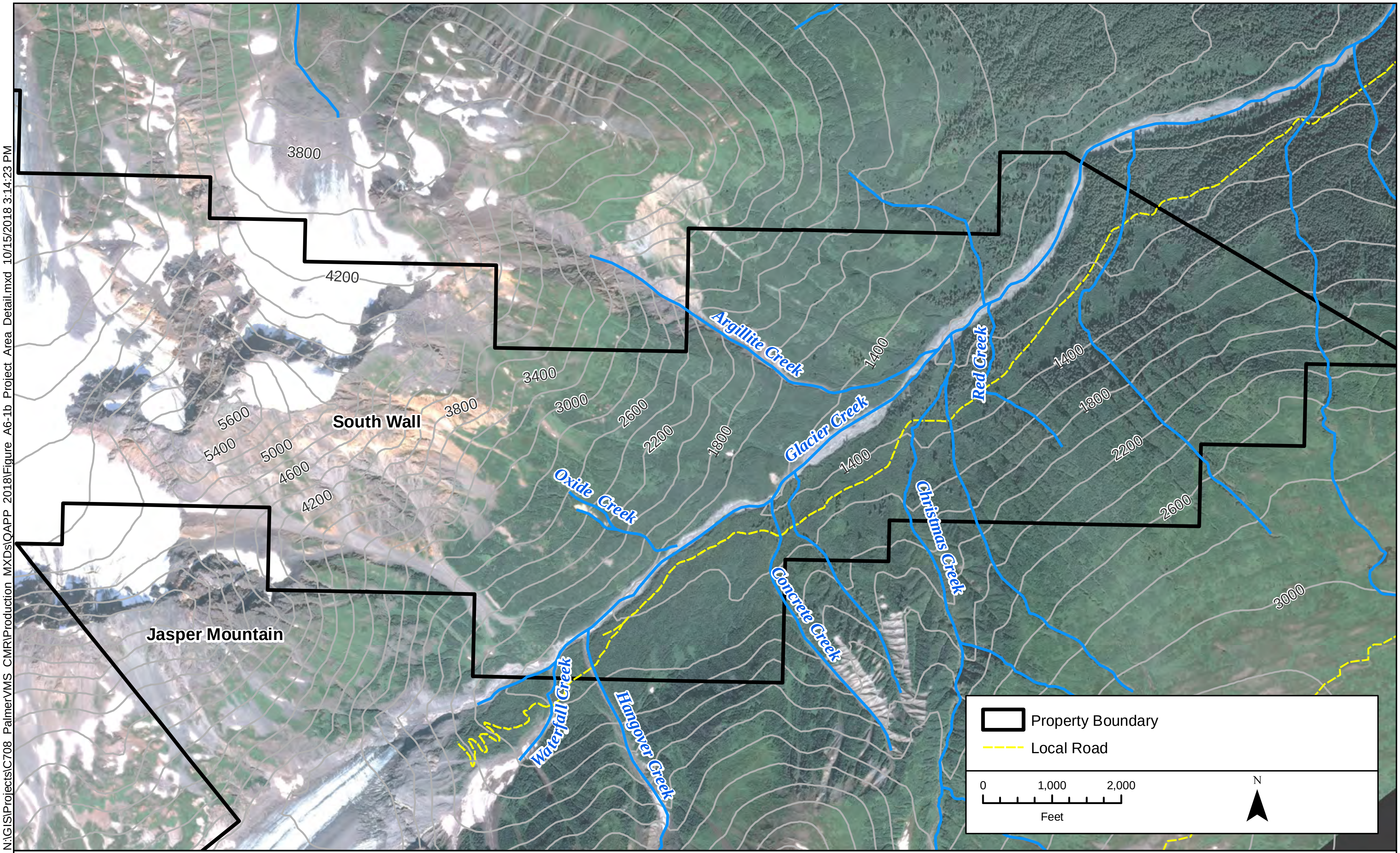


AERIAL SOURCE:
Palmer Resources Ltd. 2015.

HDR CONSTANTINE metal resources ltd.

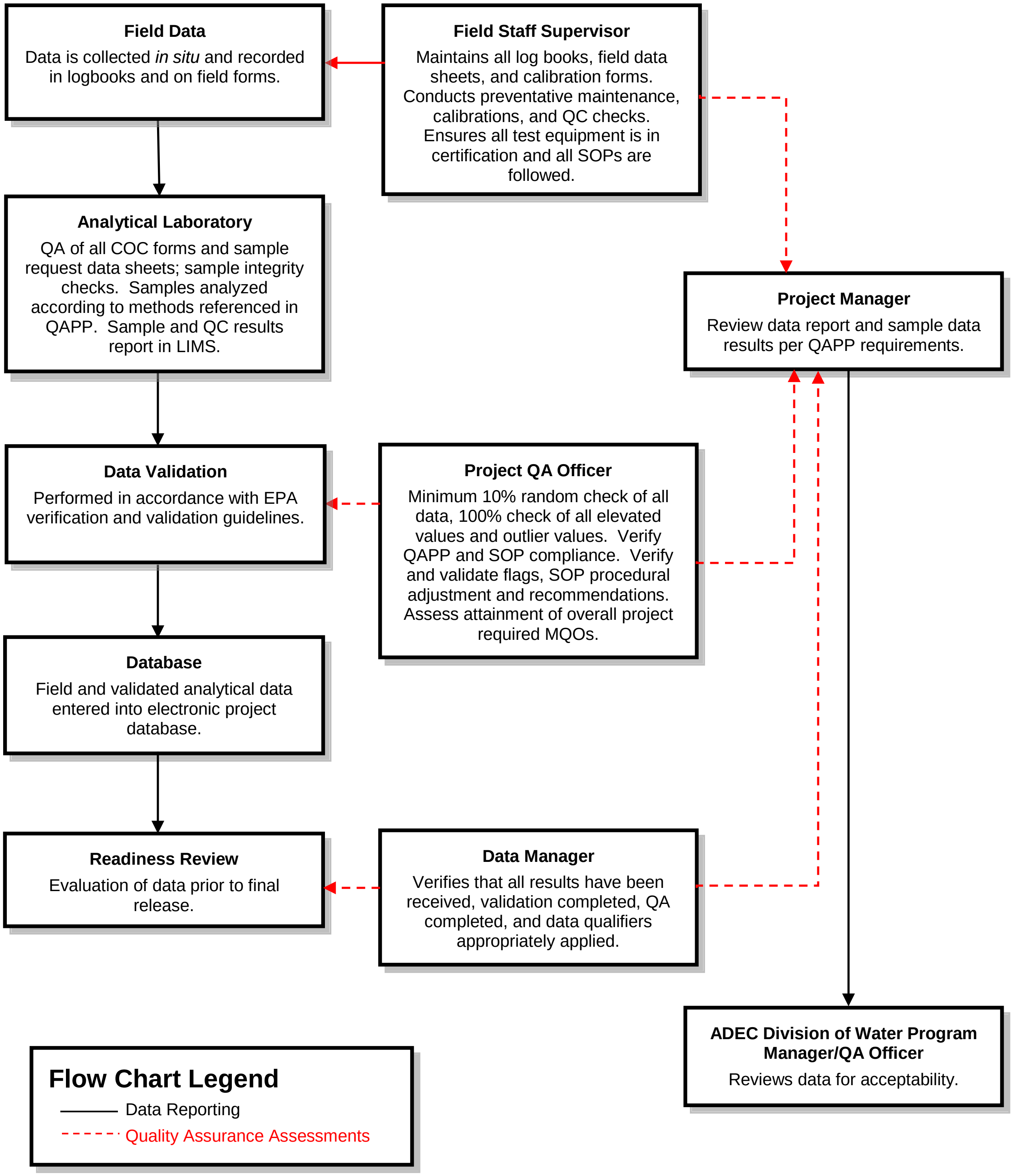
Figure A6-1a.
Palmer Project
Project Area and Regional Hydrology
Aerial Image View



Aerial Source: Palmer Resources Ltd. 2015
Contour Source: USGS 30-Meter DEM

Figure A6-1b.
Palmer Project
Project Area and Local Hydrology
Aerial Image View

N:\GIS\Projects\C708 PalmerVMS CMR\Production MXDs\QAPP 2018\Figure A6-1b Project Area Detail.mxd 10/15/2018 3:14:23 PM



Field Data

Data is collected *in situ* and recorded in logbooks and on field forms.

Field Staff Supervisor

Maintains all log books, field data sheets, and calibration forms. Conducts preventative maintenance, calibrations, and QC checks. Ensures all test equipment is in certification and all SOPs are followed.

Analytical Laboratory

QA of all COC forms and sample request data sheets; sample integrity checks. Samples analyzed according to methods referenced in QAPP. Sample and QC results report in LIMS.

Project Manager

Review data report and sample data results per QAPP requirements.

Data Validation

Performed in accordance with EPA verification and validation guidelines.

Project QA Officer

Minimum 10% random check of all data, 100% check of all elevated values and outlier values. Verify QAPP and SOP compliance. Verify and validate flags, SOP procedural adjustment and recommendations. Assess attainment of overall project required MQOs.

Database

Field and validated analytical data entered into electronic project database.

Readiness Review

Evaluation of data prior to final release.

Data Manager

Verifies that all results have been received, validation completed, QA completed, and data qualifiers appropriately applied.

ADEC Division of Water Program Manager/QA Officer

Reviews data for acceptability.

Flow Chart Legend

——— Data Reporting

- - - - - Quality Assurance Assessments

Figure B10-1.
Project Data Management Flow Chart
Palmer Project

Tables

Table A4-1. Project Organization Leads

Position	Agency/ Company	Division/ Branch/Section	Contact Information
ADEC Program Manager	ADEC	Division of Water	(907) 269-7580 gene.mccabe@alaska.gov
ADEC Water Quality Standards Manager	ADEC	Division of Water/Water Quality Standards	(907) 465-5185 brock.tabor@alaska.gov
ADEC QA Officer	ADEC	Division of Water/WQSAR/QA	(907) 465-2726 john.clark@alaska.gov
Project Manager	Constantine Mining		(604) 629-2348, (907) 766-2057 allegra@constantinemetals.com
Field Coordinator	Constantine Mining		(604) 629-2348, (907) 766-2057 allegra@constantinemetals.com
Project Manager	HDR Engineering, Inc.		(907) 644-2017 cindy.helmericks@hdrinc.com
QA Officer	HDR Engineering, Inc.		(907) 644-2017 cindy.helmericks@hdrinc.com
Data Manager	HDR Engineering, Inc.		(907) 644-2093 tobin.lilly@hdrinc.com
Laboratory Project Manager	ALS Laboratory Group	Environmental	(778) 370-3219 carla.fuginski@alsglobal.com
Laboratory QA Manager	ALS Laboratory Group	Environmental	(604) 253-4188 helen.franco@alsglobal.com

Notes:

ADEC = Alaska Department of Environmental Conservation
ALS = ALS Laboratory Group
QA = quality assurance
WQSAR = Water Quality Standards, Monitoring, and Assessment Program

Table A6-1. Water Sampling Implementation Schedule

Product	Frequency	Time Frame	Notes
QAPP	1/project, updated as needed	Summer 2018	First QAPP prepared in March 2011. QAPP update completed in September 2015. Second update completed in October 2018. Third update completed in September 2019.
Field sampling	TBD	Ongoing	Sampling stations TBD as needed.
Lab analysis	1/analytical sampling event	Ongoing	Analyses conducted within sample holding time requirements (see Table B2-2).
Data validation	1/analytical sampling event	Ongoing	Validation conducted following receipt of data results from lab.
Field audit	1/project, updated as needed	TBD	An internal field audit may be conducted by Constantine. ADEC project managers may request/perform additional field audits at their discretion.
Corrective action report (field activities)	As needed	Following internal field audit and at the discretion of field staff	Description of problem(s); recommended action(s) required; timeframe for feedback on resolution of problem(s).
Case narrative (laboratory activities	1/data package	N/A	Description of any problems encountered, control limit exceedances, and a description and rational for any deviations from analytical protocol.
On-site lab inspection audit report	As needed	N/A	On-site lab audit to be conducted on an as-needed basis in response to potential corrective actions implemented during sample analysis.
Data analysis	TBD	TBD	Analysis, review, and reporting of baseline monitoring data for water quality evaluation to be conducted as needed. Reports will include data quality summary, data completeness, precision, and bias/accuracy. Regular water quality compliance evaluations are not required for voluntary baseline monitoring.
Data review	TBD	TBD	
Data report	TBD	TBD	

Notes:
ADEC = Alaska Department of Environmental Conservation
N/A = not applicable
QAPP = quality assurance project plane
TBD = to be determined

Table A7-1. Water Sampling Measurement Quality Objectives

Group	Analyte	Sample Preparation Method	Analytical Method [a]	Units	MDL	MRL	Alaska Water Quality Standards [b]				Resolution	Precision (RPD)	Accuracy (% rec)
							Aquatic Life (fresh water)		Human Health	Drinking Water			
							Acute	Chronic	Water & Aquatic Organisms	MCL			
Field Parameters [c]	Dissolved Oxygen (concentration)	NA	SM 4500-O G	mg/L	NA	0.01	5-17	5-17	>7	>4	0.01 mg/L	--	0 to 20 mg/L, ±0.2 mg/L or ±2% of reading, whichever is greater, 20 to 50 mg/L ±6% of the reading
	Dissolved Oxygen (saturation)	NA	EPA 360.1	%	NA	0.1%	<110%	<110%	<110%	--	0.1%	--	0 to 200% (±2% of reading or 2% air saturation, whichever is greater) 200-500% (±6% of reading)
	pH	NA	SM 4500-H B	pH Units	NA	0.01	6.5 – 8.5 [d]	6.5 – 8.5 [d]	6.5 – 8.5[d]	6.5 – 8.5 [e]	0.01 pH units	--	±0.2 pH units
	Temperature	NA	SM 2550B	° C	NA	0.1	13 – 20 [f]	13 – 20 [f]	13 – 20[f]	15	0.1°C	--	±0.15 °C
	Turbidity [u]	NA	EPA 180.1	NTU	NA	0.1	NC [g]	NC [g]	NC [g]	NC [g]	0.01 NTU (0.00-10.99 NTU), 0.1 NTU (11.00-109.9 NTU), and 1 NTU (110-4000 NTU)	--	±2% (0-100 NTU), ±3% (above 100 NTU)
	Conductivity	NA	SM 2510	mS/cm	NA	0.1	--	--	--	--	0.001 mS/cm to 0.1 mS/cm (range dependent)	--	±0.5% of reading or 0.001 mS/cm, whichever is greater (4-m cable) ±1% of reading or 0.001 mS/cm, whichever is greater (20-m cable)
Conventional Analyses	Hardness as CaCO3	APHA 2340B	APHA 2340B	mg/L	0.5	1.5	--	--	--	--	--	30	80-12%
	Total Dissolved Solids	APHA 2540 C - Gravimetric	APHA 2540 C - Gravimetric	mg/L	10	30	1,000	1,000	1,000	500 [e]	--	30	85-115%
	Acidity	APHA 2310 Acidity	APHA 2310 Acidity	mg/L	1	3	--	--	--	--	--	30	85-115%
	Conductivity	APHA 2510 Auto. Conduc.	APHA 2510 Auto. Conduc.	µS/cm	2	6	--	--	--	--	--	30	90-110%
	pH	APHA 4500-H pH Value	APHA 4500-H pH Value	pH Units	0.1	0.3	6.5 – 8.5 [d]	6.5 – 8.5 [d]	6.5 – 8.5[d]	6.5 – 8.5 [e]	--	30	6.9-7.1
	Turbidity [u]	APHA 2130 Turbidity	APHA 2130 Turbidity	NTU	0.1	0.3	NC [g]	NC [g]	NC [g]	NC [g]	--	30	85-115%
	WAD Cyanide	APHA 4500-CN Cyanide	APHA 4500-CN Cyanide	mg/L	0.005	0.015	0.022	0.0052	0.7	0.2 [u]	--	30	80-120%
	Total Suspended Solids	APHA 2540 D	APHA 2540 D	mg/L	3	9	--	--	--	--	--	30	85-115%
Cations/Anions	Alkalinity as $CaCO_3$	APHA 2320 Alkalinity	APHA 2320 Alkalinity	mg/L	1	3	--	20	--	--	--	30	85–115 %
	Ammonia as N	Waston et al. [i]	Waston et al. [i]	mg/L	0.005	0.015	PD [j]	PD [k]	--	--	--	30	85–115 %
	Bromide	EPA 300.1	EPA 300.1	mg/L	0.05	0.15	--	--	--	--	--	30	85-115%
	Chloride	EPA 300.1	EPA 300.1	mg/L	0.5	1.5	860 [l]	230 [l]	--	250 [e]	--	30	90-110%
	Dissolved Organic Carbon	APHA 5310B	APHA 5310B	mg/L	0.5	0.5	--	--	--	--	--	30	--
	Fluoride	EPA 300.1	EPA 300.1	mg/L	0.02	0.06	--	--	--	4	--	30	90-110%
	Nitrate + Nitrite (complex), as N	EPA 300.0	EPA 300.0	mg/L	0.003	0.009	--	--	--	10	--	30	90-110%
	Nitrate, as N	EPA 300.1	EPA 300.1	mg/L	0.005	0.015	--	--	--	10	--	30	90-110%
	Nitrite, as N	EPA 300.1	EPA 300.1	mg/L	0.001	0.003	--	--	--	1	--	30	90-110%
	Total Phosphorus	APHA 4500-P Phosphorus	APHA 4500-P Phosphorus	mg/L	0.002	0.006	--	--	--	--	--	30	80-120%
	Total Dissolved Phosphorus	APHA 4500-P Phosphorus	APHA 4500-P Phosphorus	mg/L	0.002	0.006	--	--	--	--	--	30	80-120%
	Sulfate	EPA 300.1	EPA 300.1	mg/L	0.3	0.9	--	--	--	250 [e]	--	30	90-110%
	TDS (calculated)	APHA 1030E	APHA 1030E	--	1	3	1,000	1,000	--	500 [e]	--	30	85-115%
	Computed Conductivity	APHA 1030E	APHA 1030E	µS/cm	0.2	0.6	--	--	--	--	--	30	90-110%
	Anion Sum	APHA 1030E	APHA 1030E	--	0.1	0.3	--	--	--	--	--	30	--
	Cation Sum	APHA 1030E	APHA 1030E	--	0.1	0.3	--	--	--	--	--	30	--

	Cation - Anion Balance	APHA 1030E	APHA 1030E	--	-100	--	--	--	--	--	--	30	--
	Ion Balance	APHA 1030E	APHA 1030E	--	-100	--	--	--	--	--	--	30	--
Metals (Total and Dissolved)	Aluminum	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.001	0.003 0.003	0.75 [m]	0.087 [m, n]	--	0.05 - 0.2 [e]	--	30	80-120%
	Antimony	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0001	0.0003 0.0003	--	--	0.014	0.006	--	30	80-120%
	Arsenic	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0001	0.0003 0.0003	0.34[o]	0.15[o]	--	0.01	--	30	80-120%
	Barium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0001	0.0003 0.0003	--	--	--	2	--	30	80-120%
	Beryllium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0001	0.0003 0.0003	--	--	--	0.004	--	30	80-120%
	Bismuth	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.00005	0.00015 0.00015	--	--	--	--	--	30	80-120%
	Boron	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.01	0.03 0.03	--	--	--	--	--	30	80-120%
	Cadmium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.000005	0.000015 0.000015	HD[o]	HD[o]	--	0.005	--	30	80-120%
	Calcium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.05	0.15 0.15	--	--	--	--	--	30	80-120%
	Cesium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.00001	0.00003 0.00003	--	--	--	--	--	30	80-120%
	Chromium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0001	0.0003 0.0003	--[p]	--[p]	--	0.1[m]	--	30	80-120%
	Cobalt	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0001	0.0003 0.0003	--	--	--	--	--	30	80-120%
	Copper	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0002	0.0006 0.0006	HD[o]	HD[o]	1.3	1[e]	--	30	80-120%
	Iron	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.01	0.03 0.03	--	1.0[j]	--	0.3[e]	--	30	80-120%
	Lead	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.00005	0.00015 0.00015	HD[o]	HD[o]	--	--	--	30	80-120%
	Lithium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.001	0.003 0.003	--	--	--	--	--	30	80-120%
	Magnesium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.005	0.015 0.015	--	--	--	--	--	30	80-120%
	Manganese	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0001	0.0003 0.0003	--	--	--	0.05[e]	--	30	80-120%
	Mercury	EPA 1631E (Total) APHA 3030B/EPA 1631E (Dissolved)	EPA 1631E (Total) APHA 3030B/EPA 1631E (Dissolved)	mg/L	0.000005	0.000015 0.000015	0.0014[o]	0.00077[o]	0.00005	0.002	--	30	80-120%
	Molybdenum	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0005	0.0015 0.0015	--	--	--	--	--	30	80-120%
	Nickel	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0005	0.0015 0.0015	HD[o]	HD[o]	0.61	--	--	30	80-120%
	Phosphorus	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.05	0.15 0.15	--	--	--	--	--	30	80-120%
	Potassium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.05	0.15 0.15	--	--	--	--	--	30	80-120%

	Rubidium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0002	0.0006 0.0006	--	--	--	--	--	30	80-120%
	Selenium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.00005	0.00015 0.00015	--[q]	0.005[m,q]	0.17	0.05	--	30	80-120%
	Silicon	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.05	0.15 0.15	--	--	--	--	--	30	80-120%
	Silver	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.00001	0.00003 0.00003	HD[o]	--	--	0.1[e]	--	30	80-120%
	Sodium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.05	0.15 0.15	--	--	--	--	--	30	80-120%
	Strontium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0002	0.0006 0.0006	--	--	--	--	--	30	80-120%
	Sulfur	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.5	1.5 1.5	--	--	--	--	--	30	80-120%
	Tellurium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0002	0.0006 0.0006	--	--	--	--	--	30	80-120%
	Thallium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.00001	0.00003 0.00003	--	--	0.0017	0.002	--	30	80-120%
	Thorium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0001	0.0003 0.0003	--	--	--	--	--	30	80-120%
	Tin	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0001	0.0003 0.0003	--	--	--	--	--	30	80-120%
	Titanium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0003	0.0009 0.0009	--	--	--	--	--	30	80-120%
	Tungsten	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0001	0.0003 0.0003	--	--	--	--	--	30	80-120%
	Uranium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.00001	0.00003 0.00003	--	--	--	0.03	--	30	80-120%
	Vanadium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0005	0.0015 0.0015	--	--	--	--	--	30	80-120%
	Zinc	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.003 0.001	0.009 0.003	HD[o]	HD[o]	9.1	5[e]	--	30	80-120%
	Zirconium	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	EPA 200.2/6020A (Total) APHA 3030B/6020A (Dissolved)	mg/L	0.0002	0.0006 0.0006	--	--	--	--	--	30	80-120%
Radiochemistry	Gross Alpha	EPA 900.0	EPA 900.0	picocuries/L	--	3	--	--	--	15	--	2.13[r]	70-130%
	Radium-226	EPA 903.1	EPA 903.1	picocuries/L	--	1	--	--	--	5[s]	--	2.13[r]	67-120%

Notes:

-- = criteria not available
ALS = ALS Laboratory Group
EPA = U.S. Environmental Protection Agency
HD = hardness-dependent criteria

MCL = maximum contaminant level
MDL = method detection limit
MRL = method reporting limit
NA = not applicable

NC = natural conditions-based criteria
NTU = nephelometric turbidity units
PD = pH-dependent criteria
RPD = relative percent difference

[a] Analytical methods for ALS Environmental are adapted from the referenced methods listed in this table.

[b] Water quality criteria source documents:

Alaska Department of Environmental Conservation. Water Quality Standards. 18 AAC 70. Amended April 8, 2012.

Alaska Department of Environmental Conservation. Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. Draft. Amended December 12, 2008.

United States Environmental Protection Agency. National Primary Drinking Water Regulations. EPA 816-F-09-004. May 2009

[c] For field parameters, calibrated instruments that meet method requirements will be used.

[d] May not vary more than 0.5 pH units from natural conditions.

[e] Secondary MCL.

[f] The following maximum temperatures may not be exceeded, where applicable:

<15℃ (migration routes and rearing areas)

<13℃ (spawning and egg/fry incubation areas)

[g] For aquatic life, may not exceed 25 NTU above natural conditions. For drinking water, may not exceed 5 NTU above natural conditions (for natural turbidity < 50 NTU), or may not exceed 10% increase above natural conditions (for natural turbidity > 50 NTU).

[h] Minimum concentration as $CaCO_3$, except where natural alkalinity is lower

[i] Waston, R.J., C. Edward, V. Butler, L.A. Clementson, and K.M. Berry. 2005. Flow-injection Analysis with Fluorescence Detection for the Determination of Trace Levels of Ammonium in Seawater. *J. Environ. Monit* . 7:37-42.

[j] Acute (when fish are present) = $0.275/(1+10^{7.204-pH}) + 39.0/(1+10^{pH-7.204})$

Acute (when fish are not present) = $0.411/(1+10^{7.204-pH}) + 58.4/(1+10^{pH-7.204})$

[k] Chronic (when fish are present) = $(0.0577/(1+10^{7.688-pH}) + 2.487/(1+10^{pH-7.688})) \times MIN(2.85, 1.45 \times 10^{0.028(25-Temperature)})$

Chronic (when fish are not present) = $(0.0577/(1+10^{7.688-pH}) + 2.487/(1+10^{pH-7.688})) \times (1.45 \times 10^{0.028-(25-MAX(Temperature,7))})$

[l] Applies to dissolved chloride when associated with sodium

[m] Total recoverable

[n] For pH > 7.0 and hardness > 50 mg/L $CaCO_3$, the chronic aluminum standard is equal to the acute aluminum standard (0.75 mg/L).

[o] Dissolved

[p] Criterion for dissolved Cr (VI) is 16 µg/L (acute) and 11 µg/L (chronic). Criterion for dissolved Cr (III) is hardness dependent.

[q] EPA needs to conduct additional work to complete its review of the mercury and selenium aquatic life criteria. The current criteria may change substantially in the future.

[r] Radiochemistry precision is not evaluated with an RPD calculation. A Duplicate Error Ratio is used to include sample specific total propagated uncertainty.

[s] The criterion of 5 pCi/L applies to the combined Radium-226 and Radium-228 value.

[t] Can only be achieved for low turbidity waters; other PQL is 3.0E-03 mg/L

[u] Field-measured turbidity will be used for comparison to screening levels. Turbidity analysis will also be conducted in the laboratory to support sample preparation and analytical method decisions.

Table A8-1. Water Sampling Training Requirements

	Field Staff	Laboratory Staff	Laboratory Supervisor	Project QA Officer
Training Requirements	Qualified Contractor, Constantine	ALS Laboratory Services	ALS Laboratory Services	Qualified Contractor
Safety training	X	X	X	X
Water sampling techniques	X	NA	NA	X
Instrument calibration and QC activities for field measurements	X	NA	NA	X
Instrument calibration and QC activities for laboratory measurements	NA	X	X	X
QA principles	NA	X	X	X
QA for water monitoring systems	NA	NA	NA	X
Chain-of-custody procedures for samples and data	X	X	X	X
Handling of hazardous goods	X	X	X	X
Specific EPA-approved field measurement method training	X	NA	NA	X
Specific analytical method training	NA	X	X	NA

Notes:
EPA = U.S. Environmental Protection Agency
NA = not applicable
QA = quality assurance
QC = quality control

Table A9-1. Water Sampling Documents and Records

Categories	Record/Document Types	Report Type	Location	Retention Time
Site Information	Site maps Site pictures	QAPP	Project Manager	Project duration
Environmental Data Operations	QA Project Plan Field method SOPs Field data sheet templates	QAPP	Project Manager	Project duration
Data Management	Data management plans/flowcharts	QAPP	Project Manager	Project duration
Field Documentation	Field logbooks Sample collection/measurement forms Sample labels Sample chain-of-custody forms Custody labels Photographic documentation Field change request forms (when applicable)	Field crew/project summary data report	Project Manager	Project duration
Laboratory Documentation	Case narrative Sample receipt forms Lab data (sample, MRL, MDLs) Lab data qualifiers Sample prep logs	Lab data report	QA Manager, Laboratory	5 years
Raw Data	Electronic laboratory data	Lab LIMS	QA Manager, Laboratory	5 years
Quality Assurance	Laboratory data validation reports	Project summary data report	QA Manager, Laboratory	5 years
	Control charts Instrument tuning check data Initial and continuing calibration data Results for method and calibration blanks Results for all QA/QC checks (surrogates, internal standards, LCS/LCSD, MS/MSD, duplicates, triplicates) Instrument data quantification reports Copies of laboratory worksheets and standards	Lab data report	QA Manager, Laboratory	5 years
	Lab audits	Lab CALA accreditation	QA Manager, Laboratory	Evaluated annually
	Site field audits	Internal field audit report	QA Manager	Project duration
	Data quality assessments QA reports/corrective action reports and responses Performance Evaluation Samples	Project data reports (completed as needed)	QA Manager	Project duration

Table A9-1. Water Sampling Documents and Records

Categories	Record/Document Types	Report Type	Location	Retention Time
Data Reports	Written or electronic project data reports to be provided to ADEC (when applicable)	Data summary reports	Project Manager	Project duration

Notes:

ADEC = Alaska Department of Environmental Conservation
LIMS = Laboratory Information Management System
LCS/LCSD = laboratory control sample/laboratory control sample duplicate
MDL = method detection limit
MRL = method reporting limit
MS/MSD = matrix spike/matrix spike duplicate
QA/QC = quality assurance/quality control
QAPP = quality assurance project plan
SOP = standard operating procedure

Table B2-1. Sample Collection Methods, Containers, Preservation, and Holding Times[a]

Analysis	Matrix	Method	Container	Minimum Sample Volume	Filtration and Preservation	Maximum Holding Time	Holding Temperature
Field Parameters							
Dissolved oxygen	Water	Field	NA	NA	NA	NA	NA
pH	Water	Field	NA	NA	NA	NA	NA
Temperature	Water	Field	NA	NA	NA	NA	NA
Turbidity	Water	Field	NA	NA	NA	NA	NA
Conductivity	Water	Field	NA	NA	NA	NA	NA
Conventional Analyses and Cations/Anions							
Ammonia as N	Water	Grab	Glass	50 mL	pH < 2; 1:1 H_2SO_4	28 days	4 ± 2 ℃ do not freeze
Nitrate/nitrite (complex) as N	Water	Grab	Glass	125 mL	pH < 2; 1:1 H_2SO_4		
Nitrate, as N	Water	Grab	HDPE	250 mL	--	48 hours	
Nitrite, as N	Water	Grab		250 mL	--	48 hours	
Turbidity	Water	Grab		250 mL	--	48 hours	
Conductivity	Water	Grab		--	--	28 days	
pH	Water	Grab		250 mL	--	immediately	
WAD cyanide	Water	Grab		30 mL	pH > 12; 0.5mL 6N NaOH	14 days	
Total dissolved solids (TDS)	Water	Grab		500 mL	Laboratory filtration for TDS	7 days	
Total suspended solids (TSS)	Water	Grab					
Acidity	Water	Grab		50 mL	--	14 days	
Alkalinity as $CaCO_3$	Water	Grab					
Bromide	Water	Grab		100 mL	--	28 days	
Chloride	Water	Grab		100 mL			
Fluoride	Water	Grab					
Sulfate	Water	Grab					
Total phosphorus	Water	Grab					
Dissolved phosphorus	Water	Grab		125 mL	Field filtration for dissolved phosphorus, pH < 2; 1:1 H2SO4	28 days	
Metals Analysis							
Total metals[b]	Water	Grab	HDPE	50 mL	pH <2; 1:3 HNO_3	90 days	NA
Hardness as $CaCO_3$	Water	Grab		50 mL			
Total mercury	Water	Grab	Glass	30 mL	pH <2; 1:1 HCl	28 days	
Dissolved metals[b]	Water	Grab	HDPE	50 mL	Field filtration[c] and pH <2; 1:3 HNO_3	90 days	NA
Dissolved mercury	Water	Grab	Glass	30 mL	Field filtration[c] and pH <2; 1:1 HCl	28 days	

Table B2-1. Sample Collection Methods, Containers, Preservation, and Holding Times[a]

Analysis	Matrix	Method	Container	Minimum Sample Volume	Filtration and Preservation	Maximum Holding Time	Holding Temperature
Radiochemistry							
Gross alpha	Water	Grab	HDPE	250 mL	pH <2; 1:3 HNO_3	90 days	NA
Radium-226	Water	Grab	HDPE	1 L	pH <2; 1:3 HNO_3	90 days	NA

Notes:

-- = no filtration or preservation required
Field = *in situ* field measurement
Grab = grab sample
HDPE = high density polyethylene
HNO_3 = nitric acid
H_2SO_4 = sulfuric acid
NA = notapplicable
PET = polyethylene terephthalate
NaOH = sodium hydroxide
Water = surface or groundwater sample

[a] The specific sample collection methods, containers, preservation, and holding time recommendations presented in this table are subject to change based on the requirements of the analytical laboratory.

[b] Aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, cesium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, phosphorus, potassium, rubidium, selenium, silicon, silver, sodium, strontium, sulfur, tellurium, thallium, thorium, tin, titanium, tungsten, uranium, vanadium, zinc, zirconium

[c] Filter sample within 15 minutes of sample collection.

Table B5-1. Recommended Field and Laboratory Quality Control Samples

Quality Control Sample	Measurement Parameter	Frequency of Occurrence	QC Acceptance Criteria Limits
Field QC Samples			
Field blank	Analytical parameters	1/event	Refer to analytical method [a]
Field replicate measurement	Field and analytical	1 per 10 samples	20%
Calibration verification check standard	Specific conductance, dissolved oxygen, pH, turbidity	Beginning and end of each sampling day	20%
Laboratory QC Samples			
Initial and continuingcalibration verification check standards	Analytical parameters	Analyzed at the beginning and end of each sample analysis run and every 20 analytical samples	Refer to analytical method [a]
Initial calibration blank	Analytical parameters	Analyzed after the analytical standards	Refer to analytical method [a]
Continuing calibrationblanks	Analytical parameters	Frequency of 10% of samples or every two hours of a run	Refer to analytical method [a]
Lab preparation blank	Analytical parameters	1 per analytical batch	Refer to analytical method [a]
ICP interference check sample	Analytical parameters	Analyzed at the beginning and end of each sample analysis run and every 20 analytical samples	Refer to analytical method [a]
Laboratory control sample or SRM	Analytical parameters	1 per analytical batch	Refer to analytical method [a]
Lab duplicate sample	Analytical parameters	1 per analytical batch	Refer to analytical method [a]
Matrix spike/matrix spikeduplicate	Analytical parameters	1 per analytical batch	Refer to analytical method [a]
ICP serial dilution	Analytical parameters	1 per analytical batch	Refer to analytical method [a]

Notes:

ICP = inductively coupled plasma mass spectrometry
QC = quality control
SRM = standard reference material

Field parameters: temperature, specific conductance, dissolved oxygen, pH, and turbidity

Analytical parameters:

Conventional and physical parameters – total dissolved solids, total suspended solids, total cyanide, turbidity, acidity, and hardness
Cations and anions – alkalinity, bromide, chloride, fluoride, ammonia, nitrate, nitrate, nitrate/nitrite complex, phosphorus, sulfate
Total and dissolved metals – aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, cesium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, phosphorus, potassium, rubidium, selenium, silicon, silver, sodium, strontium, sulfur, tellurium, thallium, thorium, tin, titanium, uranium, vanadium, zinc, zirconium

Radiochemistry parameters: gross alpha, radium-226
Note that radiochemistry will be sampled only once at each station.

[a] See Appendix A. ALS Laboratory Group – CALA Accreditation

Table C3-1. Data Quality Assessments

QA Report Type	Typical Contents	Typical Presentation Method	Report Issued By	Notes
On-site FieldInspection Audit Report	Description of audit results, audit methods and standards/equipment used and any recommendations	Writtentext/tables, photographs	Third partyfield inspector	Conducted at the discretion of the Project Manager.
On-site Laboratory Audit Report	Description of audit results, audit methods and standards/equipment used and any recommendations	Writtentext/tables, charts, graphs displaying results	Project QA Officer, Auditor	– Current accreditation or certification by NELAC, Washington State DOE or other accrediting State Agency for water/wastewater analysis may be used. – On-site audit may be scheduled/performed at discretion of ADEC Program Manager/ADEC Water QA Officer Responsibility for conducting audit lies with ADEC Program Manager/Water QAOfficer.
Third PartyProficiency Test Audit Report (DMR-QA)	Description ofaudit results, methods of analysis and any recommendations	Writtentext/tables, charts, graphs displaying results	Project QA Officer, Auditor	Constantine may request DMR-QA participation from the laboratory. It is the responsibility of the laboratory to enroll itself annually in blind performance testing studies with the results mailed/e-mailed directly to the ADEC DOW Water Quality Assurance Office and the Monitoring Project's QA Officer.
Corrective Action Reports andResponses	Description ofproblem(s); recommended action(s) required; time frame for feedback on resolution of problem(s)	Writtentext/tables	Project QA Officer, Project Manager overseeing sampling and analysis	Field corrective action reports may be completed following sampling events or internal field audits, at the discretion of field staff. Laboratory corrective action reports will be included with each data package prepared by the laboratory.
Lab Data PackageCase Narrative and/or Corrective Action Reports	Description of any problems encountered, control limit exceedances, and a description and rational for any deviations from analytical protocol	Writtentext/table	Laboratory Project QA Officer	Laboratory data packages and EDDs will be prepared by the laboratories upon completion of analyses for each sample delivery group. Thecase narrative will include a description of any problems encountered, control limit exceedances, and a description and rationale for any deviations from protocol. Copies of corrective action reports generated at the laboratory will also be included with the data package.

Appendix A

ALS Laboratory Group – CALA Accreditation

THE STATE of ALASKA
GOVERNOR BILL WALKER

Department of Environmental Conservation

DIVISION OF SPILL PREVENTION AND RESPONSE
Contaminated Sites Program
Laboratory Approval Program

555 Cordova Street
Anchorage, Alaska 99501
Main: 907.465.5390
Fax: 907.269.7649
cs.lab.cert@alaska.gov

May 3, 2018

Jeff Grindstaff
ALS Environmental - Kelso
1317 S 13th Avenue
Kelso, WA 98626

RE: Contaminated Sites Laboratory Approval **17-004**

Dear Mr. Grindstaff,
Thank you for submitting an application to the Alaska Department of Environmental Conservation's Contaminated Sites Laboratory Approval Program (CS-LAP), on February 6, 2018. Based on your lab's National Environmental Laboratory Accreditation Program (NELAP) approval through the Oregon Environmental Laboratory Accreditation Program (ORELAP), ALS Environmental - Kelso, located at the above address, is granted ***Approved*** status to perform the analyses listed in the attached *Scope of Approval*, for Alaska contaminated sites projects, including underground storage tanks and leaking underground storage tank sites (UST/LUST), under the July 1, 2017 amendments to 18 AAC 78. This approval expires on ***February 10, 2019***.

Be aware that **any** changes in your NELAP approval status must be reported to the CS program within 3 business days. Failure to do so will result in revocation of **all** CS-LAP approvals for a period of one year. Notification should be in writing sent to cs.lab.cert@alaska.gov. We recommend also contacting the CS-LAP by telephone to verify that the message was received.

Please remember to include the laboratory's ID number, listed above, on all correspondence concerning the laboratory. To apply for renewal of your approval, please complete the application found on the CS-LAP webpage and submit to cs.submittals@alaska.gov. The required documentation must be submitted for renewal no later than 30 days before your date of expiration.

If you have any questions, please contact the CS-LAP at (907) 465-5390, or by email at cs.lab.cert@alaska.gov. Labs are also highly encouraged to join the CS-LAP listserv by going to http://list.state.ak.us/mailman/listinfo/cs.lab.approval.

Respectfully,

Brian Englund

Brian Englund
Alaska CS Lab Approval Ofpficer

Attachment: Scope of Approval

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
83-32-9	Soil	Acenaphthene	8270D	ORELAP
83-32-9	Water	Acenaphthene	8270D	ORELAP
83-32-9	Soil	Acenaphthene	8270D-SIM	ORELAP
83-32-9	Water	Acenaphthene	8270D-SIM	ORELAP
208-96-8	Soil	Acenaphthylene	8270D	ORELAP
208-96-8	Water	Acenaphthylene	8270D	ORELAP
208-96-8	Soil	Acenaphthylene	8270D-SIM	ORELAP
208-96-8	Water	Acenaphthylene	8270D-SIM	ORELAP
67-64-1	Soil	Acetone	8260C	ORELAP
67-64-1	Water	Acetone	8260C	ORELAP
309-00-2	Soil	Aldrin	8081B	ORELAP
309-00-2	Water	Aldrin	8081B	ORELAP
120-12-7	Soil	Anthracene	8270D	ORELAP
120-12-7	Water	Anthracene	8270D	ORELAP
120-12-7	Soil	Anthracene	8270D-SIM	ORELAP
120-12-7	Water	Anthracene	8270D-SIM	ORELAP
7440-36-0	Soil	Antimony (metallic)	6010C	ORELAP
7440-36-0	Water	Antimony (metallic)	6010C	ORELAP
7440-36-0	Soil	Antimony (metallic)	6020A	ORELAP
7440-36-0	Water	Antimony (metallic)	6020A	ORELAP
7440-38-2	Soil	Arsenic, Inorganic	6010C	ORELAP
7440-38-2	Water	Arsenic, Inorganic	6010C	ORELAP
7440-38-2	Soil	Arsenic, Inorganic	6020A	ORELAP
7440-38-2	Water	Arsenic, Inorganic	6020A	ORELAP
7440-39-3	Soil	Barium	6010C	ORELAP
7440-39-3	Water	Barium	6010C	ORELAP
7440-39-3	Soil	Barium	6020A	ORELAP
7440-39-3	Water	Barium	6020A	ORELAP
56-55-3	Soil	Benz[a]anthracene	8270D	ORELAP
56-55-3	Water	Benz[a]anthracene	8270D	ORELAP
56-55-3	Soil	Benz[a]anthracene	8270D-SIM	ORELAP
56-55-3	Water	Benz[a]anthracene	8270D-SIM	ORELAP
100-52-7	Soil	Benzaldehyde	8270D	ORELAP

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
100-52-7	Water	Benzaldehyde	8270D	ORELAP
71-43-2	Soil	Benzene	8260C	ORELAP
71-43-2	Water	Benzene	8260C	ORELAP
50-32-8	Soil	Benzo[a]pyrene	8270D	ORELAP
50-32-8	Water	Benzo[a]pyrene	8270D	ORELAP
50-32-8	Soil	Benzo[a]pyrene	8270D-SIM	ORELAP
50-32-8	Water	Benzo[a]pyrene	8270D-SIM	ORELAP
205-99-2	Soil	Benzo[b]fluoranthene	8270D	ORELAP
205-99-2	Water	Benzo[b]fluoranthene	8270D	ORELAP
205-99-2	Soil	Benzo[b]fluoranthene	8270D-SIM	ORELAP
205-99-2	Water	Benzo[b]fluoranthene	8270D-SIM	ORELAP
191-24-2	Soil	Benzo[g,h,i]perylene	8270D	ORELAP
191-24-2	Water	Benzo[g,h,i]perylene	8270D	ORELAP
191-24-2	Soil	Benzo[g,h,i]perylene	8270D-SIM	ORELAP
191-24-2	Water	Benzo[g,h,i]perylene	8270D-SIM	ORELAP
207-08-9	Soil	Benzo[k]fluoranthene	8270D	ORELAP
207-08-9	Water	Benzo[k]fluoranthene	8270D	ORELAP
207-08-9	Soil	Benzo[k]fluoranthene	8270D-SIM	ORELAP
207-08-9	Water	Benzo[k]fluoranthene	8270D-SIM	ORELAP
65-85-0	Soil	Benzoic Acid	8270D	ORELAP
65-85-0	Water	Benzoic Acid	8270D	ORELAP
100-51-6	Soil	Benzyl Alcohol	8270D	ORELAP
100-51-6	Water	Benzyl Alcohol	8270D	ORELAP
7440-41-7	Soil	Beryllium and compounds	6010C	ORELAP
7440-41-7	Water	Beryllium and compounds	6010C	ORELAP
7440-41-7	Soil	Beryllium and compounds	6020A	ORELAP
7440-41-7	Water	Beryllium and compounds	6020A	ORELAP
111-44-4	Soil	Bis(2-chloroethyl)ether	8270D	ORELAP
111-44-4	Water	Bis(2-chloroethyl)ether	8270D	ORELAP
117-81-7	Soil	Bis(2-ethylhexyl)phthalate (DEHP)	8270D	ORELAP
117-81-7	Water	Bis(2-ethylhexyl)phthalate (DEHP)	8270D	ORELAP
108-86-1	Soil	Bromobenzene	8260C	ORELAP
108-86-1	Water	Bromobenzene	8260C	ORELAP

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
75-27-4	Soil	Bromodichloromethane	8260C	ORELAP
75-27-4	Water	Bromodichloromethane	8260C	ORELAP
75-25-2	Soil	Bromoform	8260C	ORELAP
75-25-2	Water	Bromoform	8260C	ORELAP
74-83-9	Soil	Bromomethane	8260C	ORELAP
74-83-9	Water	Bromomethane	8260C	ORELAP
85-68-7	Soil	Butyl Benzyl Phthalate	8270D	ORELAP
85-68-7	Water	Butyl Benzyl Phthalate	8270D	ORELAP
104-51-8	Soil	Butylbenzene, n-	8260C	ORELAP
104-51-8	Water	Butylbenzene, n-	8260C	ORELAP
135-98-8	Soil	Butylbenzene, sec-	8260C	ORELAP
135-98-8	Water	Butylbenzene, sec-	8260C	ORELAP
98-06-6	Soil	Butylbenzene, tert-	8260C	ORELAP
98-06-6	Water	Butylbenzene, tert-	8260C	ORELAP
7440-43-9	Soil	Cadmium	6010C	ORELAP
7440-43-9	Water	Cadmium	6010C	ORELAP
7440-43-9	Soil	Cadmium	6020A	ORELAP
7440-43-9	Water	Cadmium	6020A	ORELAP
75-15-0	Soil	Carbon Disulfide	8260C	ORELAP
75-15-0	Water	Carbon Disulfide	8260C	ORELAP
56-23-5	Soil	Carbon Tetrachloride	8260C	ORELAP
56-23-5	Water	Carbon Tetrachloride	8260C	ORELAP
12789-03-6	Soil	Chlordane, Total	8081B	ORELAP
12789-03-6	Water	Chlordane, Total	8081B	ORELAP
106-47-8	Soil	Chloroaniline, p-	8270D	ORELAP
106-47-8	Water	Chloroaniline, p-	8270D	ORELAP
108-90-7	Soil	Chlorobenzene	8260C	ORELAP
108-90-7	Water	Chlorobenzene	8260C	ORELAP
67-66-3	Soil	Chloroform	8260C	ORELAP
67-66-3	Water	Chloroform	8260C	ORELAP
74-87-3	Soil	Chloromethane	8260C	ORELAP
74-87-3	Water	Chloromethane	8260C	ORELAP
91-58-7	Soil	Chloronaphthalene, Beta-	8270D	ORELAP

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
91-58-7	Water	Chloronaphthalene, Beta-	8270D	ORELAP
95-57-8	Soil	Chlorophenol, 2-	8270D	ORELAP
95-57-8	Water	Chlorophenol, 2-	8270D	ORELAP
7440-47-3	Soil	Chromium (Total)	6010C	ORELAP
7440-47-3	Water	Chromium (Total)	6010C	ORELAP
7440-47-3	Soil	Chromium (Total)	6020A	ORELAP
7440-47-3	Water	Chromium (Total)	6020A	ORELAP
18540-29-9	Soil	Chromium (VI)	7196	ORELAP
18540-29-9	Water	Chromium (VI)	7196	ORELAP
218-01-9	Soil	Chrysene	8270D	ORELAP
218-01-9	Water	Chrysene	8270D	ORELAP
218-01-9	Soil	Chrysene	8270D-SIM	ORELAP
218-01-9	Water	Chrysene	8270D-SIM	ORELAP
7440-50-8	Soil	Copper	6010C	ORELAP
7440-50-8	Water	Copper	6010C	ORELAP
7440-50-8	Soil	Copper	6020A	ORELAP
7440-50-8	Water	Copper	6020A	ORELAP
108-39-4	Soil	Cresol, m- (3-Methylphenol)	8270D	ORELAP
108-39-4	Water	Cresol, m- (3-Methylphenol)	8270D	ORELAP
95-48-7	Soil	Cresol, o- (2-Methylphenol)	8270D	ORELAP
95-48-7	Water	Cresol, o- (2-Methylphenol)	8270D	ORELAP
106-44-5	Soil	Cresol, p- (4-Methylphenol)	8270D	ORELAP
106-44-5	Water	Cresol, p- (4-Methylphenol)	8270D	ORELAP
98-82-8	Soil	Cumene (Isopropylbenzene)	8260C	ORELAP
98-82-8	Water	Cumene (Isopropylbenzene)	8260C	ORELAP
57-12-5	Soil	Cyanide	9012B	ORELAP
110-82-7	Water	Cyclohexane	8260C	ORELAP
72-54-8	Soil	DDD, 4,4’-	8081B	ORELAP
72-54-8	Water	DDD, 4,4’-	8081B	ORELAP
72-55-9	Soil	DDE, 4,4’-	8081B	ORELAP
72-55-9	Water	DDE, 4,4’-	8081B	ORELAP
50-29-3	Soil	DDT, 4,4’-	8081B	ORELAP
50-29-3	Water	DDT, 4,4’-	8081B	ORELAP

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
53-70-3	Soil	Dibenz[a,h]anthracene	8270D	ORELAP
53-70-3	Water	Dibenz[a,h]anthracene	8270D	ORELAP
53-70-3	Soil	Dibenz[a,h]anthracene	8270D-SIM	ORELAP
132-64-9	Soil	Dibenzofuran	8270D	ORELAP
132-64-9	Water	Dibenzofuran	8270D	ORELAP
132-64-9	Soil	Dibenzofuran	8270D-SIM	ORELAP
132-64-9	Water	Dibenzofuran	8270D-SIM	ORELAP
124-48-1	Soil	Dibromochloromethane	8260C	ORELAP
124-48-1	Water	Dibromochloromethane	8260C	ORELAP
106-93-4	Soil	Dibromoethane, 1,2- (Ethylene Dibromide)	8011	ORELAP
106-93-4	Water	Dibromoethane, 1,2- (Ethylene Dibromide)	8011	ORELAP
106-93-4	Soil	Dibromoethane, 1,2- (Ethylene Dibromide)	8260C	ORELAP
106-93-4	Water	Dibromoethane, 1,2- (Ethylene Dibromide)	8260C	ORELAP
74-95-3	Soil	Dibromomethane (Methylene Bromide)	8260C	ORELAP
74-95-3	Water	Dibromomethane (Methylene Bromide)	8260C	ORELAP
84-74-2	Soil	Dibutyl Phthalate	8270D	ORELAP
84-74-2	Water	Dibutyl Phthalate	8270D	ORELAP
95-50-1	Soil	Dichlorobenzene, 1,2-	8260C	ORELAP
95-50-1	Water	Dichlorobenzene, 1,2-	8260C	ORELAP
95-50-1	Soil	Dichlorobenzene, 1,2-	8270D	ORELAP
95-50-1	Water	Dichlorobenzene, 1,2-	8270D	ORELAP
541-73-1	Soil	Dichlorobenzene, 1,3-	8260C	ORELAP
541-73-1	Water	Dichlorobenzene, 1,3-	8260C	ORELAP
541-73-1	Soil	Dichlorobenzene, 1,3-	8270D	ORELAP
541-73-1	Water	Dichlorobenzene, 1,3-	8270D	ORELAP
106-46-7	Soil	Dichlorobenzene, 1,4-	8260C	ORELAP
106-46-7	Water	Dichlorobenzene, 1,4-	8260C	ORELAP
106-46-7	Soil	Dichlorobenzene, 1,4-	8270D	ORELAP
106-46-7	Water	Dichlorobenzene, 1,4-	8270D	ORELAP
91-94-1	Soil	Dichlorobenzidine, 3,3'-	8270D	ORELAP
91-94-1	Water	Dichlorobenzidine, 3,3'-	8270D	ORELAP
75-71-8	Soil	Dichlorodifluoromethane	8260C	ORELAP
75-71-8	Water	Dichlorodifluoromethane	8260C	ORELAP

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
75-34-3	Soil	Dichloroethane, 1,1-	8260C	ORELAP
75-34-3	Water	Dichloroethane, 1,1-	8260C	ORELAP
107-06-2	Soil	Dichloroethane, 1,2-	8260C	ORELAP
107-06-2	Water	Dichloroethane, 1,2-	8260C	ORELAP
75-35-4	Soil	Dichloroethylene, 1,1-	8260C	ORELAP
75-35-4	Water	Dichloroethylene, 1,1-	8260C	ORELAP
156-59-2	Soil	Dichloroethylene, 1,2-cis-	8260C	ORELAP
156-59-2	Water	Dichloroethylene, 1,2-cis-	8260C	ORELAP
156-60-5	Soil	Dichloroethylene, 1,2-trans-	8260C	ORELAP
156-60-5	Water	Dichloroethylene, 1,2-trans-	8260C	ORELAP
120-83-2	Soil	Dichlorophenol, 2,4-	8270D	ORELAP
120-83-2	Water	Dichlorophenol, 2,4-	8270D	ORELAP
78-87-5	Soil	Dichloropropane, 1,2-	8260C	ORELAP
78-87-5	Water	Dichloropropane, 1,2-	8260C	ORELAP
542-75-6	Soil	Dichloropropene, 1,3- (cis + trans)	8260C	ORELAP
542-75-6	Water	Dichloropropene, 1,3- (cis + trans)	8260C	ORELAP
60-57-1	Soil	Dieldrin	8081B	ORELAP
60-57-1	Water	Dieldrin	8081B	ORELAP
N/A	Soil	Diesel Range Organics (C10 – C25)	AK 102	ORELAP
N/A	Water	Diesel Range Organics (C10 – C25)	AK 102	ORELAP
84-66-2	Soil	Diethyl Phthalate	8270D	ORELAP
84-66-2	Water	Diethyl Phthalate	8270D	ORELAP
105-67-9	Soil	Dimethylphenol, 2,4-	8270D	ORELAP
105-67-9	Water	Dimethylphenol, 2,4-	8270D	ORELAP
131-11-3	Soil	Dimethylphthalate	8270D	ORELAP
131-11-3	Water	Dimethylphthalate	8270D	ORELAP
51-28-5	Soil	Dinitrophenol, 2,4-	8270D	ORELAP
51-28-5	Water	Dinitrophenol, 2,4-	8270D	ORELAP
121-14-2	Soil	Dinitrotoluene, 2,4- (2,4-DNT)	8270D	ORELAP
121-14-2	Water	Dinitrotoluene, 2,4- (2,4-DNT)	8270D	ORELAP
606-20-2	Soil	Dinitrotoluene, 2,6- (2,6-DNT)	8270D	ORELAP
606-20-2	Water	Dinitrotoluene, 2,6- (2,6-DNT)	8270D	ORELAP
115-29-7	Soil	Endosulfan (Endosulfan I + Endosulfan II)	8081B	ORELAP

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
115-29-7	Water	Endosulfan (Endosulfan I + Endosulfan II)	8081B	ORELAP
72-20-8	Soil	Endrin	8081B	ORELAP
72-20-8	Water	Endrin	8081B	ORELAP
75-00-3	Soil	Ethyl Chloride	8260C	ORELAP
75-00-3	Water	Ethyl Chloride	8260C	ORELAP
100-41-4	Soil	Ethylbenzene	8260C	ORELAP
100-41-4	Water	Ethylbenzene	8260C	ORELAP
206-44-0	Soil	Fluoranthene	8270D	ORELAP
206-44-0	Water	Fluoranthene	8270D	ORELAP
206-44-0	Soil	Fluoranthene	8270D-SIM	ORELAP
206-44-0	Water	Fluoranthene	8270D-SIM	ORELAP
86-73-7	Soil	Fluorene	8270D	ORELAP
86-73-7	Water	Fluorene	8270D	ORELAP
86-73-7	Soil	Fluorene	8270D-SIM	ORELAP
86-73-7	Water	Fluorene	8270D-SIM	ORELAP
N/A	Soil	Gasoline Range Organics (C6 – C10)	AK 101	ORELAP
N/A	Water	Gasoline Range Organics (C6 – C10)	AK 101	ORELAP
76-44-8	Soil	Heptachlor	8081B	ORELAP
76-44-8	Water	Heptachlor	8081B	ORELAP
1024-57-3	Soil	Heptachlor Epoxide	8081B	ORELAP
1024-57-3	Water	Heptachlor Epoxide	8081B	ORELAP
118-74-1	Soil	Hexachlorobenzene	8270D	ORELAP
118-74-1	Water	Hexachlorobenzene	8270D	ORELAP
87-68-3	Soil	Hexachlorobutadiene	8270D	ORELAP
87-68-3	Water	Hexachlorobutadiene	8270D	ORELAP
319-84-6	Soil	Hexachlorocyclohexane, Alpha- (α-BHC)	8081B	ORELAP
319-84-6	Water	Hexachlorocyclohexane, Alpha- (α-BHC)	8081B	ORELAP
319-85-7	Soil	Hexachlorocyclohexane, Beta- (β-BHC)	8081B	ORELAP
319-85-7	Water	Hexachlorocyclohexane, Beta- (β-BHC)	8081B	ORELAP
319-86-8	Water	Hexachlorocyclohexane, Delta- (δ-BHC)	8081B	ORELAP
58-89-9	Soil	Hexachlorocyclohexane, Gamma- (Lindane)	8081B	ORELAP
58-89-9	Water	Hexachlorocyclohexane, Gamma- (Lindane)	8081B	ORELAP
77-47-4	Soil	Hexachlorocyclopentadiene	8270D	ORELAP

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
77-47-4	Water	Hexachlorocyclopentadiene	8270D	ORELAP
67-72-1	Soil	Hexachloroethane	8270D	ORELAP
67-72-1	Water	Hexachloroethane	8270D	ORELAP
591-78-6	Soil	Hexanone, 2-	8260C	ORELAP
591-78-6	Water	Hexanone, 2-	8260C	ORELAP
193-39-5	Soil	Indeno[1,2,3-cd]pyrene	8270D	ORELAP
193-39-5	Water	Indeno[1,2,3-cd]pyrene	8270D	ORELAP
193-39-5	Soil	Indeno[1,2,3-cd]pyrene	8270D-SIM	ORELAP
193-39-5	Water	Indeno[1,2,3-cd]pyrene	8270D-SIM	ORELAP
78-59-1	Soil	Isophorone	8270D	ORELAP
78-59-1	Water	Isophorone	8270D	ORELAP
7439-92-1	Soil	Lead, Total	6010C	ORELAP
7439-92-1	Water	Lead, Total	6010C	ORELAP
7439-92-1	Soil	Lead, Total	6020A	ORELAP
7439-92-1	Water	Lead, Total	6020A	ORELAP
7439-97-6	Soil	Mercury (elemental)	1631E	ORELAP
7439-97-6	Water	Mercury (elemental)	1631E	ORELAP
7439-97-6	Water	Mercury (elemental)	7470A	ORELAP
7439-97-6	Soil	Mercury (elemental)	7471A	ORELAP
7439-97-6	Soil	Mercury (elemental)	7471B	ORELAP
72-43-5	Soil	Methoxychlor	8081B	ORELAP
72-43-5	Water	Methoxychlor	8081B	ORELAP
78-93-3	Soil	Methyl Ethyl Ketone (2-Butanone)	8260C	ORELAP
78-93-3	Water	Methyl Ethyl Ketone (2-Butanone)	8260C	ORELAP
108-10-1	Soil	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	8260C	ORELAP
108-10-1	Water	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	8260C	ORELAP
22967-92-6	Soil	Methyl Mercury	1630	ORELAP
22967-92-6	Water	Methyl Mercury	1630	ORELAP
1634-04-4	Soil	Methyl tert-Butyl Ether (MTBE)	8260C	ORELAP
1634-04-4	Water	Methyl tert-Butyl Ether (MTBE)	8260C	ORELAP
75-09-2	Soil	Methylene Chloride	8260C	ORELAP
75-09-2	Water	Methylene Chloride	8260C	ORELAP
90-12-0	Soil	Methylnaphthalene, 1-	8270D	ORELAP

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
90-12-0	Water	Methylnaphthalene, 1-	8270D	ORELAP
90-12-0	Soil	Methylnaphthalene, 1-	8270D-SIM	ORELAP
90-12-0	Water	Methylnaphthalene, 1-	8270D-SIM	ORELAP
91-57-6	Soil	Methylnaphthalene, 2-	8270D	ORELAP
91-57-6	Water	Methylnaphthalene, 2-	8270D	ORELAP
91-57-6	Soil	Methylnaphthalene, 2-	8270D-SIM	ORELAP
91-57-6	Water	Methylnaphthalene, 2-	8270D-SIM	ORELAP
91-20-3	Soil	Naphthalene	8260C	ORELAP
91-20-3	Soil	Naphthalene	8270D	ORELAP
91-20-3	Water	Naphthalene	8270D	ORELAP
91-20-3	Soil	Naphthalene	8270D-SIM	ORELAP
91-20-3	Water	Naphthalene	8270D-SIM	ORELAP
7440-02-0	Soil	Nickel, Total	6010C	ORELAP
7440-02-0	Water	Nickel, Total	6010C	ORELAP
7440-02-0	Soil	Nickel, Total	6020A	ORELAP
7440-02-0	Water	Nickel, Total	6020A	ORELAP
98-95-3	Soil	Nitrobenzene	8270D	ORELAP
98-95-3	Water	Nitrobenzene	8270D	ORELAP
62-75-9	Soil	Nitrosodimethylamine, N-	8270D	ORELAP
62-75-9	Water	Nitrosodimethylamine, N-	8270D	ORELAP
621-64-7	Soil	Nitroso-di-N-propylamine, N-	8270D	ORELAP
621-64-7	Water	Nitroso-di-N-propylamine, N-	8270D	ORELAP
86-30-6	Soil	Nitrosodiphenylamine, N-	8270D	ORELAP
86-30-6	Water	Nitrosodiphenylamine, N-	8270D	ORELAP
117-84-0	Soil	Octyl Phthalate, di-N-	8270D	ORELAP
117-84-0	Water	Octyl Phthalate, di-N-	8270D	ORELAP
12674-11-2	Soil	PCB - Aroclor-1016	8082A	ORELAP
12674-11-2	Water	PCB - Aroclor-1016	8082A	ORELAP
11104-28-2	Soil	PCB - Aroclor-1221	8082A	ORELAP
11104-28-2	Water	PCB - Aroclor-1221	8082A	ORELAP
11141-16-5	Soil	PCB - Aroclor-1232	8082A	ORELAP
11141-16-5	Water	PCB - Aroclor-1232	8082A	ORELAP
53469-21-9	Soil	PCB - Aroclor-1242	8082A	ORELAP

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
53469-21-9	Water	PCB - Aroclor-1242	8082A	ORELAP
12672-29-6	Soil	PCB - Aroclor-1248	8082A	ORELAP
12672-29-6	Water	PCB - Aroclor-1248	8082A	ORELAP
11097-69-1	Soil	PCB - Aroclor-1254	8082A	ORELAP
11097-69-1	Water	PCB - Aroclor-1254	8082A	ORELAP
11096-82-5	Soil	PCB - Aroclor-1260	8082A	ORELAP
11096-82-5	Water	PCB - Aroclor-1260	8082A	ORELAP
37324-23-5	Soil	PCB - Aroclor-1262	8082A	ORELAP
37324-23-5	Water	PCB - Aroclor-1262	8082A	ORELAP
11100-14-4	Soil	PCB - Aroclor-1268	8082A	ORELAP
11100-14-4	Water	PCB - Aroclor-1268	8082A	ORELAP
87-86-5	Soil	Pentachlorophenol	8270D	ORELAP
87-86-5	Water	Pentachlorophenol	8270D	ORELAP
1763-23-1	Water	Perfluorooctane Sulphonic Acid (PFOS)	537	ORELAP
335-67-1	Water	Perfluorooctanoic acid (PFOA)	537	ORELAP
85-01-8	Soil	Phenanthrene	8270D	ORELAP
85-01-8	Water	Phenanthrene	8270D	ORELAP
85-01-8	Soil	Phenanthrene	8270D-SIM	ORELAP
85-01-8	Water	Phenanthrene	8270D-SIM	ORELAP
108-95-2	Soil	Phenol	8270D	ORELAP
108-95-2	Water	Phenol	8270D	ORELAP
103-65-1	Soil	Propyl benzene	8260C	ORELAP
103-65-1	Water	Propyl benzene	8260C	ORELAP
129-00-0	Soil	Pyrene	8270D	ORELAP
129-00-0	Water	Pyrene	8270D	ORELAP
129-00-0	Soil	Pyrene	8270D-SIM	ORELAP
129-00-0	Water	Pyrene	8270D-SIM	ORELAP
N/A	Soil	Residual Range Organics (C25 – C36)	AK 103	ORELAP
N/A	Water	Residual Range Organics (C25 – C36)	AK 103	ORELAP
7782-49-2	Soil	Selenium	6010C	ORELAP
7782-49-2	Water	Selenium	6010C	ORELAP
7782-49-2	Soil	Selenium	6020A	ORELAP
7782-49-2	Water	Selenium	6020A	ORELAP

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
7440-22-4	Soil	Silver	6010C	ORELAP
7440-22-4	Water	Silver	6010C	ORELAP
7440-22-4	Soil	Silver	6020C	ORELAP
100-42-5	Soil	Styrene	8260C	ORELAP
100-42-5	Water	Styrene	8260C	ORELAP
630-20-6	Soil	Tetrachloroethane, 1,1,1,2-	8260C	ORELAP
630-20-6	Water	Tetrachloroethane, 1,1,1,2-	8260C	ORELAP
79-34-5	Soil	Tetrachloroethane, 1,1,2,2-	8260C	ORELAP
79-34-5	Water	Tetrachloroethane, 1,1,2,2-	8260C	ORELAP
127-18-4	Soil	Tetrachloroethylene	8260C	ORELAP
127-18-4	Water	Tetrachloroethylene	8260C	ORELAP
7440-28-0	Soil	Thallium, Total	6010C	ORELAP
7440-28-0	Water	Thallium, Total	6010C	ORELAP
7440-28-0	Soil	Thallium, Total	6020A	ORELAP
7440-28-0	Water	Thallium, Total	6020A	ORELAP
108-88-3	Soil	Toluene	8260C	ORELAP
108-88-3	Water	Toluene	8260C	ORELAP
N/A	Water	Total Organic Carbon	9060	ORELAP
N/A	Water	Total Organic Carbon	SM 5310 B	ORELAP
8001-35-2	Soil	Toxaphene	8081B	ORELAP
8001-35-2	Water	Toxaphene	8081B	ORELAP
76-13-1	Soil	Trichloro-1,2,2-trifluoroethane, 1,1,2- (Freon 113)	8260C	ORELAP
76-13-1	Water	Trichloro-1,2,2-trifluoroethane, 1,1,2- (Freon 113)	8260C	ORELAP
87-61-6	Soil	Trichlorobenzene, 1,2,3-	8260C	ORELAP
87-61-6	Water	Trichlorobenzene, 1,2,3-	8260C	ORELAP
120-82-1	Soil	Trichlorobenzene, 1,2,4-	8260C	ORELAP
120-82-1	Water	Trichlorobenzene, 1,2,4-	8260C	ORELAP
120-82-1	Soil	Trichlorobenzene, 1,2,4-	8270D	ORELAP
71-55-6	Soil	Trichloroethane, 1,1,1-	8260C	ORELAP
71-55-6	Water	Trichloroethane, 1,1,1-	8260C	ORELAP
79-00-5	Soil	Trichloroethane, 1,1,2-	8260C	ORELAP
79-00-5	Water	Trichloroethane, 1,1,2-	8260C	ORELAP
79-01-6	Soil	Trichloroethylene	8260C	ORELAP

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accrediting Body
79-01-6	Water	Trichloroethylene	8260C	ORELAP
75-69-4	Soil	Trichlorofluoromethane	8260C	ORELAP
75-69-4	Water	Trichlorofluoromethane	8260C	ORELAP
95-95-4	Soil	Trichlorophenol, 2,4,5-	8270D	ORELAP
95-95-4	Water	Trichlorophenol, 2,4,5-	8270D	ORELAP
88-06-2	Soil	Trichlorophenol, 2,4,6-	8270D	ORELAP
88-06-2	Water	Trichlorophenol, 2,4,6-	8270D	ORELAP
96-18-4	Soil	Trichloropropane, 1,2,3-	8260C	ORELAP
96-18-4	Water	Trichloropropane, 1,2,3-	8260C	ORELAP
95-63-6	Soil	Trimethylbenzene, 1,2,4-	8260C	ORELAP
95-63-6	Water	Trimethylbenzene, 1,2,4-	8260C	ORELAP
108-67-8	Soil	Trimethylbenzene, 1,3,5-	8260C	ORELAP
108-67-8	Water	Trimethylbenzene, 1,3,5-	8260C	ORELAP
7440-62-2	Soil	Vanadium, Total	6010C	ORELAP
7440-62-2	Water	Vanadium, Total	6010C	ORELAP
7440-62-2	Soil	Vanadium, Total	6020A	ORELAP
7440-62-2	Water	Vanadium, Total	6020A	ORELAP
108-05-4	Soil	Vinyl Acetate	8260C	ORELAP
108-05-4	Water	Vinyl Acetate	8260C	ORELAP
75-01-4	Soil	Vinyl Chloride	8260C	ORELAP
75-01-4	Water	Vinyl Chloride	8260C	ORELAP
N/A	Soil	Xylene, m+p-	8260C	ORELAP
95-47-6	Soil	Xylene, o-	8260C	ORELAP
1330-20-7	Soil	Xylene, Total	8260C	ORELAP
1330-20-7	Water	Xylene, Total	8260C	ORELAP
7440-66-6	Soil	Zinc, Total	6010C	ORELAP
7440-66-6	Water	Zinc, Total	6010C	ORELAP
7440-66-6	Soil	Zinc, Total	6020A	ORELAP
7440-66-6	Water	Zinc, Total	6020A	ORELAP

Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

ALS Laboratory Group - Environmental Division (Whitehorse)
ALS Canada Ltd.
151 Industrial Road, Unit 12
Whitehorse, Yukon

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Accreditation No.:	A3826
Issued On:	July 27, 2017
Accreditation Date:	April 12, 2006
Expiry Date:	January 25, 2020

Andrew M. Adams
President & CEO

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Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

ALS Environmental (Vancouver)
ALS Canada Ltd.
8081 Lougheed Highway
Suite 100
Burnaby, British Columbia

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Accreditation No.: A1719
Issued On: December 12, 2018
Accreditation Date: January 3, 2005
Expiry Date: June 11, 2021

Andrew M. Adams
President & CEO

ILAC-MRA CALA

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CALA Directory of Laboratories

Membership Number:	1719
Laboratory Name:	ALS Environmental (Vancouver)
Parent Institution:	ALS Canada Ltd.
Address:	8081 Lougheed Highway Suite 100 Burnaby BC V5A 1W9
Contact:	Ms. Helenita Franco
Phone:	(604) 253-4188
Fax:	(604) 253-6700
Email:	quality.vancouver@ALSGlobal.com

Standard:	Conforms with requirements of ISO/IEC 17025
Clients Served:	All Interested Parties
Revised On:	February 25, 2019
Valid To:	June 11, 2021

Scope of Accreditation

Air (Inorganic)
Dustfall - Air [Dustfall] (227)
VA-TM-1039; ASTM D1739-98 and BC MOE LABORATORY MANUAL
GRAVIMETRIC
- Fixed Dustfall
- Total Dustfall
- Total Insoluble Dustfall
- Total Soluble Dustfall

Air (Inorganic)
Mercury - Dustfall (271)
NA-TM-1005, NA-TP-2012, VA-TP-2063; modified from BC MOE LABORATORY MANUAL and EPA 1631E
COLD VAPOUR AAS - DIGESTION
- Mercury

Air (Inorganic)
Metals - Air [Dustfall] (224)
NA-TM-1002, NA-TP-2007, VA-TP-2063; modified from BC MOE LABORATORY MANUAL and EPA 6020B
ICP/MS - DIGESTION
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Bismuth
- Boron
- Cadmium
- Calcium
- Chromium

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† "OSDWA" indicates the appendix is used for the analysis of Ontario drinking water samples, which is subject to the rules and related regulations under the Ontario "Safe Drinking Water Act" (2002).

The list of tests and measurement capabilities for which a laboratory is accredited can change at any time due to circumstances such as scope extensions, voluntary withdrawal of tests by the laboratory and suspension. Scopes are published by the CALA via the Internet at http://www.cala.ca/cala_directories.html

Cobalt
Copper
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Potassium
Selenium
Silver
Sodium
Strontium
Thallium
Tin
Uranium
Vanadium
Zinc

Air (Inorganic)

Total Particulates - Air [Filter, Particulate] (035)
VA-TM-1041; modified from ASTM D2009-65 and BC WORKERS COMPENSATION BOARD STANDARDS (BCWCB) 1150

GRAVIMETRIC

Respirable Dust
Total Particulate

Air (Organic)

Volatile Organic Compounds (VOC) - Air (206)
VA-TM-1109; modified from EPA TO-17

GC/MS

1,1-Biphenyl
1,1-Dichloroethane
1,1-Dichloroethylene
1,1-Dichloropropylene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2-Trichlorotrifluoroethane
1,1,2,2-Tetrachloroethane
1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,3-Butadiene
1,3-Dichlorobenzene
1,3-Dichloropropane
1,3,5-Trimethylbenzene
1,4-Dichlorobenzene
2-Butanone (Methyl ethyl ketone, MEK)

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2-Chlorophenol
2-Chlorotoluene
2-Hexanone (MBK)
2-Propanol
2,2-Dichloropropane
4-Chlorotoluene
4-Isopropyltoluene
4-Methyl-2-pentanone (MIBK)
Acetone
Benzene
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform
Bromomethane
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropylene
Cyclohexane
Decane
Dibromochloromethane
Dibromomethane
Dichlorodifluoromethane
Dichloromethane (Methylene Chloride)
Ethyl acetate
Ethylbenzene
Hexachlorobutadiene
Isopropylbenzene
m,p-Xylene
Methyl t-butyl ether (MTBE)
Methylcyclohexane
n-Butylbenzene
n-Heptane
n-Hexane
n-Octane
n-Propylbenzene
Naphthalene
o-Xylene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane
Vinyl chloride

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Air (Organic)
Volatile Organic Compounds (VOC) - Air (207)
VA-TM-1109; modified from EPA TO-17
GC/FID
F1: C6-C10
F2: C10-C16
Total Volatile Organic Compounds (TVOC): >C10-C12
Total Volatile Organic Compounds (TVOC): >C12-C16
Total Volatile Organic Compounds (TVOC): >C6-C8
Total Volatile Organic Compounds (TVOC): >C8-C10
Volatile Hyrocarbons (VH): C6-C13

Dust (Inorganic)
Soluble Anions - Dustfall (255)
NA-TM-1001, VA-TM-1039; modified from BC MOE LABORATORY MANUAL and EPA 300.0 and SM 4110
ION CHROMATOGRAPHY
Chloride
Nitrate

Food
Arsenic Speciation - Food [Egg, Fresh Fruit, Meat, Processed Food, Vegetables] (236)
NA-TM-1002, NA-TP-2007, VA-TM-1082; modified from CFIA SOM-DAR-CHE-053-04 and EPA 6020A
HPLC - ICP/MS
Arsenate (As(V))
Arsenite (As(III))
Arsenobetaine (AsB)
Arsenocholine (AsC)
Dimethyl arsinic acid (DMA)
Monomethyl arsenate (MMA)

Food (Inorganic)
Methyl mercury - Seafood (272)
NA-TM-1002, VA-TM-1088; modified from FDA METHOD 4.8
HPLC - ICP/MS
Methyl Mercury

Oil (Organic)
Total Polychlorinated Biphenyls (PCB) - Oil (080)
VA-TM-1118, VA-TP-2116; modified from EPA 3620C and EPA 3660B and EPA 3665A and EPA 600/4-81-045 and EPA 8082A
GC/ECD
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
PCB-1016
PCB-1221
PCB-1232
PCB-1262
PCB-1268
Total PCB

Paint (Inorganic)
Lead - Paint (261)
NA-TM-1002, NA-TP-2004; modified from EPA 200.2 and EPA 6020B
ICP/MS - DIGESTION
Lead

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Seawater (Inorganic)
Dissolved Metals - Water [Seawater] (118)
NA-TM-1002, NA-TP-2002, NA-TP-2007, VA-TM-1076; modified from EPA 200.8 and PUGET SOUND PROTOCOLS

ICP/MS - EXTRACTION/FILTRATION

- Cadmium
- Cobalt
- Copper
- Iron
- Lead
- Manganese
- Nickel
- Uranium
- Zinc

Seawater (Inorganic)
Dissolved Metals - Water [Seawater] (204)
NA-TP-2002, VA-TM-1068, VA-TP-2074; modified from EPA 200.8 and SM 3030 B

HI RESOLUTION ICP/MS-Filtration

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Bismuth
- Boron
- Cadmium
- Calcium
- Cesium
- Chromium
- Cobalt
- Copper
- Gallium
- Iron
- Lead
- Lithium
- Magnesium
- Manganese
- Molybdenum
- Nickel
- Phosphorus
- Potassium
- Rhenium
- Rubidium
- Selenium
- Silicon
- Silver
- Sodium
- Strontium
- Tellurium
- Thallium
- Thorium
- Tin
- Titanium

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Tungsten
Uranium
Vanadium
Yttrium
Zinc
Zirconium

Seawater (Inorganic)

Total Metals - Water [Seawater] (205)
NA-TP-2001, VA-TM-1068, VA-TP-2074; modified from EPA 200.8 and SM 3030 E
HI RESOLUTION ICP/MS-Digestion

Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Gallium
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Rhenium
Rubidium
Selenium
Silicon
Silver
Sodium
Strontium
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Uranium
Vanadium
Yttrium
Zinc
Zirconium

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Seawater (Inorganic)
Total Metals - Water [Seawater] (222)
NA-TM-1002, NA-TP-2001, NA-TP-2007, VA-TM-1076; modified from EPA 6020B and PUGET SOUND PROTOCOLS
ICP/MS - EXTRACTION/DIGESTION
Cadmium
Cobalt
Copper
Iron
Lead
Manganese
Nickel
Uranium
Zinc

Soil (Inorganic)
Acidity - Soil (257)
VA-TM-1053, VA-TM-1074; modified from MEND REPORT 1.20.1 and SM 2320 B
TITRIMETRIC - SHAKEFLASK EXTRACTION
Acidity

Soil (Inorganic)
Alkalinity - Soil (258)
VA-TM-1053, VA-TM-1074; modified from MEND REPORT 1.20.1 and SM 2320 B
TITRIMETRIC - SHAKEFLASK EXTRACTION
Alkalinity

Soil (Inorganic)
Anions - Leachates (256)
NA-TM-1001, VA-TM-1078; modified from BC MOE LABORATORY MANUAL and EPA 300.0 and SM 4110
ION CHROMATOGRAPHY (IC) - FIXED RATIO EXTRACTION
Chloride
Chloride
Sulfate
Sulphate

Soil (Inorganic)
Leachable Anions - Solids [Soil] (244)
NA-TM-1001, VM-TM-1074; modified from EPA 300.1 and MEND REPORT 1.20.1
IC - SHAKEFLASK EXTRACTION
Bromide
Chloride
Fluoride
Nitrate as Nitrogen
Nitrite as Nitrogen
Sulfate

Soil (Inorganic)
Leachable Metals - Solids [Soil] (247)
NA-TM-1002, NA-TP-2007, VA-TM-1074; modified from EPA 6020B and MEND REPORT 1.20.1
ICP/MS - SHAKEFLASK EXTRACTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron

Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Thallium
Tin
Uranium
Vanadium
Zinc

Soil (Inorganic)
pH - Solids [Soil] (250)
VA-TM-1074; modified from MEND REPORT 1.20.1 and SM 4500-H
pH METER-Shake flask Extraction
pH

Soil (Microbiology)
Fecal (Thermotolerant) Coliforms - Solids [Soil] (245)
VA-TM-1200; modified from EPA 1680
MOST PROBABLE NUMBER
Fecal (Thermotolerant) Coliforms

Solids (Inorganic)
Acid Volatile Sulphide (AVS) - Solids [Soil] (230)
VA-TM-1021; modified from EPA 821-R-91-100
COLORIMETRIC - EXTRACTION
Acid Volatile Sulfides

Solids (Inorganic)
Anions - Solids [Soil] (148)
NA-TM-1001, VA-TP-2066; modified from EPA 300.1 and SM 4110 B and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
IC-SATURATED EXTRACTION
Bromide
Chloride
Fluoride
Nitrate-N
Nitrite
Sulphate

Solids (Inorganic)
Conductivity - Solids [Soil] (147)
VA-TM-1053, VA-TP-2066; modified from SM 2510 B and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
METER - SATURATION EXTRACTION
Conductivity

Solids (Inorganic)
Cyanide - Solids [Soil] (213)
NA-TM-1003, VA-WI-3019; modified from BC MOE LABORATORY MANUAL and ISO 14403 and ON MOECC E3015 and SM 4500-CN- I
AUTO COLOR - DISTILLATION-EXTRACTION
Cyanide (SAD)
Cyanide (WAD)

Solids (Inorganic)
Cyanide - Solids [Soil] (214)
NA-TM-1003, VA-WI-3019; modified from ASTM 7237 and BC MOE LABORATORY MANUAL and ON MOECC E3015
AUTO COLOR/GAS DIFFUSION-EXTRACTION
Cyanide, Free

Solids (Inorganic)
Flashpoint - Waste (264)
VA-TM-1090; modified from ASTM D93-15
PENSKE-MARTEN CLOSED CUP
Flashpoint

Solids (Inorganic)
Leachable Mercury - Soil (270)
NA-TM-1005, NA-TP-2012, VA-TM-1074; modified from MEND REPORT 1.20.1
COLD VAPOUR AA - SPECTROMETRIC SHAKE FLASK EXTRACTION
Mercury

Solids (Inorganic)
Leachable Mercury - Waste (267)
NA-TM-1005, NA-TP-2012, VA-TM-1071; modified from BC MOE ENVIRONMENTAL MANAGEMENT ACT HAZARDOUS WASTE REGULATION (EMA/HWR) and EPA 1631E
CVAAS-MELP EXTRACTION
Mercury

Solids (Inorganic)
Leachable Mercury - Waste (268)
NA-TM-1005, NA-TM-1700, NA-TP-2012; modified from EPA 1311 (PREPARATION) and EPA 1631E (ANALYSIS)
COLD VAPOUR AA - TCLP EXTRACTION
Mercury

Solids (Inorganic)
Leachable Metals - Solids (121)
VA-TM-1066, VA-TM-1071, VA-TP-2072; modified from BC MOE ENVIRONMENTAL MANAGEMENT ACT HAZARDOUS WASTE REGULATION (EMA/HWR) and EPA 6010D
ICP/OES- MLEP EXTRACTION
Arsenic
Barium
Boron
Cadmium
Chromium
Copper
Lead

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Selenium
Silver
Uranium
Zinc

Solids (Inorganic)
Leachable Metals - Solids (122)
NA-TM-1700, VA-TM-1066, VA-TP-2072; modified from EPA 1311 (PREPARATION) and EPA 6010D (ANALYSIS)

ICP/OES - EXTRACTION - TCLP

Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Nickel
Selenium
Silver
Thallium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Leachable Metals - Solids [Soil] (235)
NA-TM-1002, NA-TM-1700, NA-TP-2007; modified from BC PROTOCOL 13 (ANALYSIS) and EPA 1311 (PREPARATION) and EPA 6020B (ANALYSIS)

ICP/MS - Extraction - TCLP

Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Nickel
Selenium
Silver
Thallium
Uranium
Vanadium

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Zinc
Zirconium

Solids (Inorganic)
Mercury - Soil (269)
NA-TM-1005, NA-TP-2004, NA-TP-2012; modified from BC MOE LABORATORY MANUAL, SALM (PREPARATION) and EPA 1631E (ANALYSIS) and EPA 200.2 (ANALYSIS)
COLD VAPOUR AAS - DIGESTION
Mercury

Solids (Inorganic)
Metals - Solids [Soil] (152)
NA-TM-1002, NA-TP-2004, NA-TP-2007; modified from BC MOE LABORATORY MANUAL, SALM (PREPARATION) and EPA 200.2 (ANALYSIS) and EPA 6020B (ANALYSIS)
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Thallium
Tin
Titanium
Uranium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Metals - Solids [Soil] (153)
VA-TM-1066, VA-TP-2066, VA-TP-2072; modified from EPA 6010D and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
ICP/OES - SATURATION EXTRACTION
Calcium
Magnesium
Potassium

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Sodium

Solids (Inorganic)
Methyl Mercury - Solids [Soil] (173)
VA-TM-1062; modified from EPA 1630
P&T - GC - CVAFS - EXTRACTION
Methylmercury

Solids (Inorganic)
Moisture - Solids [Soil] (089)
NA-TM-1200; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD
GRAVIMETRIC
Percent Moisture

Solids (Inorganic)
Oil and Grease - Solids [Soil] (239)
VA-TM-1125; modified from BC MOE LABORATORY MANUAL
GRAVIMETRIC - EXTRACTION
Mineral Oil and Grease
Oil and Grease

Solids (Inorganic)
Paint Filter - Soil, Waste (262)
VA-TM-1055; modified from EPA 9095B
FILTRATION
Paint Filter (Free Liquid)

Solids (Inorganic)
Percent Saturation - Solids [Saturated Paste] (149)
VA-TP-2066; modified from SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
SATURATION EXTRACTION
Percent Saturation

Solids (Inorganic)
pH - Solids [Soil] (120)
VA-TM-1078, VA-TP-2066; modified from SM 4500-H+ B and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
METER - SATURATION EXTRACTION
pH

Solids (Inorganic)
pH - Solids [Soil] (169)
VA-TM-1078; modified from BC MOE LABORATORY MANUAL and SM 4500-H+ B
METER - FIXED RATIO EXTRACTION
pH

Solids (Inorganic)
Simultaneously Extracted Metals (SEM) - Solids [Soil] (228)
NA-TM-1005, NA-TP-2011, NA-TP-2012, VA-TM-1021; modified from EPA 1631E and EPA 821-R-91-100
CVAFS - SEM EXTRACTION
Mercury

Solids (Inorganic)
Simultaneously Extracted Metals (SEM) - Solids [Soil] (229)
VA-TM-1021, VA-TM-1066, VA-TP-2072; modified from EPA 6010D and EPA 821-R-91-100
ICP/OES - SEM EXTRACTION
Arsenic
Cadmium
Copper
Lead
Nickel

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Zinc

Solids (Inorganic)
Waste Oil - Solids (123)
VA-TM-1111; BC MOE LABORATORY MANUAL
GRAVIMETRIC - EXTRACTION
Waste Oil Content

Solids (Organic)
Extractable Hydrocarbons - Solids [Soil] (184)
NA-TM-1106, NA-TP-2106; modified from BC MOE LABORATORY MANUAL and EPA 3570
GC/FID - EXTRACTION (COLD SHAKE)
EPH C10-C19
EPH C10-C19 (sg)
EPH C19-C32
EPH C19-C32 (sg)

Solids (Organic)
Glycols - Solids [Soil] (156)
VA-TM-1113; modified from EPA 8015B
GC/FID - EXTRACTION
1,2-Propylene glycol
Diethylene glycol
Ethylene glycol
Triethylene glycol

Solids (Organic)
Organochlorine (OC) Pesticides - Solids [Soil] (079)
VA-TM-1121, VA-TP-2117; modified from EPA 3540C and EPA 3630C and EPA 3660B and EPA 8081B
GC/ECD - EXTRACTION
2,4'-DDD
2,4'-DDE
2,4'-DDT (o,p'-DDT)
4,4'-DDD
4,4'-DDE
4,4-DDT (p,p'-DDT)
Aldrin
alpha-BHC
beta-BHC
cis-Chlordane (alpha)
cis-Nonachlor
delta-BHC
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
gamma-BHC (Lindane)
Heptachlor
Heptachlor epoxide
Methoxychlor
Mirex
Oxychlordane
trans-Chlordane
trans-Nonachlor

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Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (189)
NA-TM-1100, NA-TP-2100; modified from ALBERTA ENVIRONMENT INTERPRETATION, SEPT 2003 and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD (DEC 2000 NO. 1310)
GC/FID - TUMBLER EXTRACTION

F2: C10-C16
F3: C16-C34
F4: C34-C50

Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (190)
NA-TM-1100; modified from ALBERTA ENVIRONMENT INTERPRETATION, SEPT 2003 and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD (DEC 2000 NO. 1310)
GRAVIMETRIC - TUMBLER EXTRACTION

F4: Gravimetric
F4G-SG: Gravimetric Heavy Hydrocarbons - Silica

Solids (Organic)
Phenols - Solids [Soil] (071)
VA-TM-1122, VA-TP-2113; modified from EPA 3570 and EPA 8270D and KNAPP 1979
GC/MS - EXTRACTION

2-Chlorophenol
2,3-Dichlorophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-Tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol
2,4-Dichlorophenol + 2,5-Dichlorophenol
2,4-Dimethylphenol
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,6-Dichlorophenol
3-Chlorophenol
3,4-Dichlorophenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
4-Chloro-3-methyl phenol
4-Chlorophenol
m-Cresol
o-Cresol
p-Cresol
Pentachlorophenol
Phenol

Solids (Organic)
Polycyclic Aromatic Hydrocarbons (PAH) - Solids [Soil] (185)
NA-TM-1106, NA-TP-2103; modified from EPA 3570 and EPA 8270D
GC/MS - EXTRACTION (COLD SHAKE)

2-Methylnaphthalene
Acenaphthene
Acenaphthylene
Anthracene
Benzo (a) anthracene
Benzo (a) pyrene

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Benzo (b,j) fluoranthene
Benzo (g,h,i) perylene
Benzo (k) fluoranthene
Chrysene
Dibenzo (a,h) anthracene
Fluoranthene
Fluorene
Indeno (1,2,3 - cd) pyrene
Naphthalene
Phenanthrene
Pyrene
Quinoline

Solids (Organic)
Polycyclic Aromatic Hydrocarbons (PAH) - Solids [Soil] (203)
NA-TM-1105, NA-TP-2103; modified from EPA 3570 and EPA 8270D

GC/MS - EXTRACTION (SHORT COLD SHAKE)

2-Methylnaphthalene
Acenaphthene
Acenaphthylene
Anthracene
Benzo (a) anthracene
Benzo (a) pyrene
Benzo (b,j) fluoranthene
Benzo (g,h,i) perylene
Benzo (k) fluoranthene
Chrysene
Dibenzo (a,h) anthracene
Fluoranthene
Fluorene
Indeno (1,2,3 - cd) pyrene
Naphthalene
Phenanthrene
Pyrene

Solids (Organic)
Total Polychlorinated Biphenyls (PCB) - Solids [Soil] (112)
VA-TM-1119, VA-TP-2116; modified from EPA 3570 and EPA 3620C and EPA 3660B and EPA 3665A and EPA 8082A

GC/ECD - EXTRACTION

Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
PCB-1016
PCB-1221
PCB-1232
PCB-1262
PCB-1268
Total PCB

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Solids (Organic)
Volatile Hydrocarbons (VH) - Solids [Soil] (202)
NA-TM-1102, NA-TP-2102; modified from BC MOE LABORATORY MANUAL and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD and EPA 5021A
GC/FID - HEADSPACE
F1: C6-C10
VH: C6-C10

Solids (Organic)
Volatile Organic Compounds (VOC) - Solids (263)
NA-TM-1102, VA-TM-1126; modified from EPA 1311 (PREPARATION) and EPA 8260C (ANALYSIS)
GC/MS - HEADSPACE - TCLP
1,1-Dichloroethene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,4-Dichlorobenzene
Benzene
Bromodichloromethane
Bromoform
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroform
Ethylbenzene
m&p-xylenes
Methyl ethyl ketone
Methylene chloride
o-Xylene
Tetrachloroethylene
Toluene
Trichloroethylene
Vinyl chloride

Solids (Organic)
Volatile Organic Compounds (VOC) - Solids [Soil] (201)
NA-TM-1102, NA-TP-2102; modified from EPA 5021A and EPA 8260C
GC/MS - HEADSPACE
1,1-Dichloroethane
1,1-Dichloroethylene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,2,4-Trimethylbenzene
1,3-Dichlorobenzene
1,3,5-Trimethylbenzene
1,4-Dichlorobenzene
4-Isopropylbenzene
Benzene
Bromodichloromethane
Bromoform
Carbon Tetrachloride

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Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Cumene (Isopropylbenzene)
Dichloromethane
Ethylbenzene
Ethylene Dibromide
m/p-xylene
Methyl t-butyl ether
n-Propylbenzene
Naphthalene
o-xylene
Styrene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane
Vinyl chloride

Swab (Organic)
Total Polychlorinated Biphenyls (PCB) - Solids [Swab] (249)
VA-TM-1120, VA-TP-2116; modified from EPA 3620C and EPA 3660B and EPA 3665A and EPA 8082A
GC/ECD - EXTRACTION
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
PCB-1262
PCB-1268

Tissue (Inorganic)
Ashfree - Tissue (259)
VM-TM-1051; modified from SM 10300
GRAVIMETRIC
Ash-free weight

Tissue (Inorganic)
Lipid Content - Tissue (241)
VA-TM-1112; modified from EPA 3570 and EPA 8290A
GRAVIMETRIC
Lipid Content

Tissue (Inorganic)
Methyl Mercury - Tissue (172)
VA-TM-1062; modified from EPA 1630
P&T - GC - CVAFS - DIGESTION
Methylmercury

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Tissue (Inorganic)
Moisture - Tissue (090)
VA-TM-1087; modified from PUGET SOUND PROTOCOLS
GRAVIMETRIC
Moisture %

Tissue (Inorganic)
Selenium Speciation - Tissue (253)
NA-TM-1002, NA-TP-2007, VA-TM-1085; CFIA METHOD SOM-DAR CHE-053-04
HPLC - ICP/MS
Selenium (IV)
Selenium (VI)
SelenoMethionine

Tissue (Inorganic)
Total Mercury - Tissue (266)
NA-TM-1005, NA-TP-2006, NA-TP-2012; modified from EPA 1631E and EPA 200.3
COLD VAPOUR AA - SPECTROMETRIC
Mercury

Tissue (Inorganic)
Total Metals - Tissue (100)
NA-TM-1002, NA-TP-2006, NA-TP-2007; modified from EPA 200.3 and EPA 6020A
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Rubidium
Selenium
Silver
Sodium
Strontium
Sulfur
Tellurium
Thallium
Tin
Titanium

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Uranium
Vanadium
Zinc
Zirconium

Tissue (Inorganic)
Total Metals - Tissue (200)
NA-TP-2006, VA-TM-1068, VA-TP-2074, VA-TP-2077; modified from EPA 200.3 and EPA 200.8
HI RESOLUTION ICP/MS - DIGESTION

Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Iron
Lanthanum
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Rubidium
Selenium
Silver
Sodium
Strontium
Sulfur
Tellurium
Thallium
Thorium
Tin
Titanium
Uranium
Vanadium
Zinc
Zirconium

Urine (Inorganic)
Creatinine - Biomaterials [Urine] (234)
VA-TM-1052; THERMO DRI CREATININE-DETECT SPECIMEN VALIDITY TEST
COLORIMETRIC

Creatinine

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Urine (Organic)
Arsenic Speciation - Biomaterials [Urine] (233)
NA-TM-1002, NA-TP-2007, VA-TM-1081; modified from CDC METHOD ID ITU003B, 2004 and EPA 6020A
HPLC-ICPMS
Arsenate (As(V))
Arsenite (As(III))
Arsenobetaine (AsB)
Dimethylarsenic acid (DMA)
Monomethyl arsenate (MMA)
Total Arsenic Species
Total Inorganic Arsenic
Total Inorganic Arsenic and Methylated Metabolites

Water (Inorganic)
Acidity - Water (219)
VA-TM-1053; modified from SM 2310
TITRIMETRIC
Acidity

Water (Inorganic)
Alkalinity - Water (001)
VA-TM-1053; modified from SM 2320 B
TITRIMETRIC
Alkalinity (pH 4.5)
Alkalinity-Bicarbonate
Alkalinity-Carbonate
Alkalinity-Hydroxide
Alkalinity-Phenolphthalein

Water (Inorganic)
Ammonia - Water (208)
VA-TM-1024; JOURNAL OF ENVIRONMENTAL MONITORING (2005) SECTION 7, P. 37-42
AUTO-FLUORESCENCE
Ammonia

Water (Inorganic)
Anions - Water (026)
NA-TM-1001; modified from EPA 300.1
IC
Bromide
Chloride
Fluoride
Nitrate
Nitrate plus Nitrite
Nitrite
Sulfate

Water (Inorganic)
Arsenic - Water (232)
NA-TM-1002, NA-TP-2007, VA-TM-1086; modified from USGS Water Resources Investigation Report 02-4144
HPLC - ICPMS
Arsenate (AsV)
Arsenite (ASIII)
Arsenobetaine (AsB)
Dimethylarsenic acid (DMA)
Monomethyl arsenate (MMA)
Total Arsenic Species
Total Inorganic Arsenic

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Total Inorganic Arsenic and Methylated Metabolites

Water (Inorganic)
Biochemical Oxygen Demand (BOD) - Water (027)
VA-TM-1032; modified from SM 5210 B
D.O. METER
BOD (5 day)
CBOD (5 day)
Soluble Biological Oxygen Demand (BOD)

Water (Inorganic)
Carbon - Water (091)
VA-TM-1037; modified from SM 5310 B
IR - COMBUSTION
Inorganic Carbon
Organic Carbon
Total Carbon

Water (Inorganic)
Chemical Oxygen Demand (COD) - Water (028)
VA-TM-1033; modified from SM 5220 D
COLOR - DIGESTION
COD

Water (Inorganic)
Chlorophyll A - Water (220)
VA-TM-1038, VA-TP-2011; modified from EPA 445.0
FLUORIMETRY
Chlorophyll a

Water (Inorganic)
Colour - Water (015)
VA-TM-1004; modified from BC MOE Laboratory Manual and SM 2120 C
COLORIMETRIC
Apparent Colour
True Colour

Water (Inorganic)
Conductivity - Water (004)
VA-TM-1053; modified from SM 2510 B
CONDUCTIVITY METER
Conductivity (25˚C)

Water (Inorganic)
Cyanide - Water (209)
NA-TM-1003 ; modified from ISO 14403 and SM 4500-CN- I
AUTO COLOR - DISTILLATION
Cyanide (SAD)
Cyanide (WAD)

Water (Inorganic)
Cyanide - Water (210)
NA-TM-1003; modified from ASTM D7237
AUTO COLOR (GAS DIFFUSION)
Cyanide, Free

Water (Inorganic)
Dissolved Ferrous Iron - Water (242)
VA-TM-1046, VA-TP-2009; modified from SM 3500-FE
COLORIMETRIC - FILTRATION
Ferrous Iron

Water (Inorganic)
Dissolved Metals - Water (032)
NA-TM-1002, NA-TP-2002, NA-TP-2007; modified from EPA 6020B and SM 3030 B
ICP/MS - FILTRATION

Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Gallium
Gold
Indium
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Rubidium
Selenium
Silicon
Silver
Sodium
Strontium
Sulfur
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Uranium
Vanadium
Zinc
Zirconium

Water (Inorganic)
Dissolved Metals - Water (036)
NA-TP-2002, VA-TM-1066, VA-TP-2072; modified from EPA 6010D and SM 3030 B
ICP/OES
Aluminum
Antimony
Arsenic

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Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Thallium
Tin
Titanium
Vanadium
Zinc

Water (Inorganic)
Dissolved Metals - Water (198)
NA-TP-2002, VA-TM-1068, VA-TP-2074; modified from EPA 200.8 and SM 3030 B
HI RESOLUTION ICP/MS - FILTRATION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Gallium
Iron
Lanthanum
Lead
Lithium
Magnesium
Manganese
Molybdenum

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Nickel
Niobium
Phosphorus
Potassium
Rhenium
Rubidium
Selenium
Silicon
Silver
Sodium
Strontium
Tantalum
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Uranium
Vanadium
Yttrium
Zinc
Zirconium

Water (Inorganic)
Fluoride - Water (005)
VA-TM-1016; modified from SM 4500-F- C
SIE
Fluoride

Water (Inorganic)
Mercury - Water (136)
NA-TM-1005, NA-TP-2002, VA-TP-2068; modified from EPA 1631E
CVAFS - BrCl DIGESTION
Mercury

Water (Inorganic)
Mercury - Water (265)
NA-TM-1005, NA-TP-2002, NA-TP-2012; modified from EPA 1631E
COLD VAPOUR AA - SPECTROMETRIC
Mercury

Water (Inorganic)
Methyl Mercury - Water (192)
VA-TM-1062; modified from EPA 1630
P&T GC-CVAFS-DISTILLATION
Methylmercury

Water (Inorganic)
Nitrogen - Water (217)
VA-TM-1047, VA-WI-3046; modified from SM 4500-P J
AUTO COLOR - DIGESTION
Total Dissolved Nitrogen
Total Nitrogen

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Water (Inorganic)
Oil and Grease - Water (061)
NA-TM-1107; modified from EPA 1664
GRAVIMETRIC - EXTRACTION
Mineral Oil and Grease
Total Oil and Grease

Water (Inorganic)
pH - Water (018)
VA-TM-1053; modified from SM 4500-H+ B
pH METER
pH

Water (Inorganic)
Phosphorus - Water (179)
VA-TM-1025, VA-TP-2009, VA-WI-3046; modified from SM 4500-P B and SM 4500-P E
COLOR - DIGESTION (AUTOCLAVE)
Phosphate
Total Dissolved Phosphorus
Total Phosphorus

Water (Inorganic)
Reactive Silica - Water (008)
VA-TM-1018; modified from SM 4500-SIO2 D
COLORIMETRIC
Reactive Silica

Water (Inorganic)
Selenium Speciation - Water (252)
NA-TM-1002, NA-TP-2007, VA-TM-1084; Spectrochimica Acta Part B60 (2005) 633-641
HPLC - ICP/MS
Selenium (IV)
Selenium (VI)
SelenoMethionine

Water (Inorganic)
Solids - Water (016)
NA-TM-1004, VA-TM-1009, VA-TM-1050; modified from SM 2540 B and SM 2540 C and SM 2540 D and SM 2540 E
GRAVIMETRIC
Fixed Suspended Solids
Total Dissolved Solids
Total Solids
Total Suspended Solids
Volatile Suspended Solids

Water (Inorganic)
Sulphide - Water (010)
VA-TM-1020; modified from SM 4500-S2- D
COLOR
Sulphide

Water (Inorganic)
Thiocyanate - Water (014)
VA-TM-1029; modified from SM 4500-CN- M
COLOR
Thiocyanate

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Water (Inorganic)
Total Kjeldahl Nitrogen (TKN) - Water (211)
VA-TM-1044; modified from SM 4500-NORG D

AUTO FLUORESCENCE - DIGESTION

- Dissolved Kjeldahl Nitrogen
- Total Kjeldahl Nitrogen

Water (Inorganic)
Total Metals - Water (031)
NA-TM-1002, NA-TP-2001, NA-TP-2007; modified from EPA 200.2 and EPA 6020B

ICP/MS - DIGESTION

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Bismuth
- Boron
- Cadmium
- Calcium
- Cesium
- Chromium
- Cobalt
- Copper
- Gallium
- Gold
- Indium
- Iron
- Lead
- Lithium
- Magnesium
- Manganese
- Molybdenum
- Nickel
- Phosphorus
- Potassium
- Rubidium
- Selenium
- Silicon
- Silver
- Sodium
- Strontium
- Sulfur
- Tellurium
- Thallium
- Thorium
- Tin
- Titanium
- Tungsten
- Uranium
- Vanadium
- Zinc
- Zirconium

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Water (Inorganic)

Total Metals - Water (041)

NA-TP-2001, VA-TM-1066, VA-TP-2072; modified from EPA 6010D and SM 3030 E

ICP/OES - DIGESTION

Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Selenium
Silicon
Silver
Sodium
Strontium
Thallium
Tin
Titanium
Vanadium
Zinc

Water (Inorganic)

Total Metals - Water (199)

NA-TP-2001, VA-TM-1068, VA-TP-2074; modified from EPA 200.8 and SM 3030 E

HI RESOLUTION ICP/MS - DIGESTION

Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper

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Gallium
Iron
Lanthanum
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Niobium
Phosphorus
Potassium
Rhenium
Rubidium
Selenium
Silicon
Silver
Sodium
Strontium
Tantalum
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Uranium
Vanadium
Yttrium
Zinc
Zirconium

Water (Inorganic)
Turbidity - Water (020)
VA-TM-1011; modified from SM 2130 B
TURBIDIMETRIC
Turbidity

Water (Inorganic)
UV Absorbance and Transmittance - Water (254)
VA-TM-1042, VA-TP-2011; modified from SM 5910 B
SPECTROPHOTOMETRIC
UV Absorbance
UV Transmittance

Water (Microbiology)
Coliforms - Water (145)
NA-TM-1300; modified from SM 9223 B
MOST PROBABLE NUMBER (ENZYME SUBSTRATE)
Escherichia coli
Fecal (Thermotolerant) Coliforms
Total Coliforms

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Water (Microbiology)
Enterococci - Water (186)
VA-TM-1203; modified from SM 9230 C
    MEMBRANE FILTRATION (mENTEROCOCCUS)
    Enterococci

Water (Microbiology)
Escherichia coli (E. coli) - Water (240)
VA-TM-1201; modified from SM 9222 G
    MEMBRANE FILTRATION (mFC/NA-MUG)
    Escherichia coli

Water (Microbiology)
Fecal (Thermotolerant) Coliforms - Water (029)
VA-TM-1200; modified from SM 9221 E
    MOST PROBABLE NUMBER
    Fecal (Thermotolerant) Coliforms

Water (Microbiology)
Fecal (Thermotolerant) Coliforms - Water (030)
VA-TM-1201; modified from SM 9222 D
    MEMBRANE FILTRATION (mFC)
    Fecal (Thermotolerant) Coliforms

Water (Microbiology)
Heterotrophic Plate Count (HPC) - Water (126)
NA-TM-1301; modified from SM 9215 B
    POUR PLATE (PLATE COUNT AGAR)
    Heterotrophic Plate Count (HPC)

Water (Microbiology)
Pseudomonas aeruginosa - Water (187)
VA-TM-1204; modified from SM 9213 E
    MEMBRANE FILTRATION (mPAC)
    Pseudomonas aeruginosa

Water (Microbiology)
Total Coliforms - Water (142)
VA-TM-1200; modified from SM 9221 B
    MOST PROBABLE NUMBER
    Total Coliforms

Water (Microbiology)
Total Coliforms - Water (143)
VA-TM-1201; modified from SM 9222 B
    MEMBRANE FILTRATION (mENDO)
    Total Coliforms

Water (Organic)
Extractable Petroleum Hydrocarbons (EPH) - Water (251)
NA-TM-1112, VA-TP-2127, VA-TP-2129; BC MOE LABORATORY MANUAL
    GC/FID - EXTRACTION
    EPH C10-C19
    EPH C10-C19 (sg)
    EPH C19-C32
    EPH C19-C32 (sg)
    Total Extractable Hydrocarbons (TEH): C10-C30

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The list of tests and measurement capabilities for which a laboratory is accredited can change at any time due to circumstances such as scope extensions, voluntary withdrawal of tests by the laboratory and suspension. Scopes are published by the CALA via the Internet at http://www.cala.ca/cala_directories.html

Water (Organic)
Glycols - Water (155)
VA-TM-1113; modified from EPA 8015C
GC/FID - EXTRACTION
1,2-Propylene glycol
Diethylene glycol
Ethylene glycol
Triethylene glycol

Water (Organic)
Organochlorine (OC) Pesticides - Water (065)
VA-TM-1121, VA-TP-2117; modified from EPA 3510C and EPA 3630C and EPA 3660B and EPA 8081B
GC/ECD - EXTRACTION
2,4’-DDD
2,4’-DDE
2,4’-DDT
4,4’-DDD
4,4’-DDE
4,4’-DDT
A -BHC
a - Chlordane
Aldrin
beta-BHC
cis-Nonachlor
delta-BHC
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
g - Chlordane
Heptachlor
Heptachlor Epoxide
Lindane (gamma-BHC)
Mirex
o,p' - DDT
Oxychlordane
p,p' - DDT
p,p' Methoxychlor
trans-Nonachlor

Water (Organic)
Petroleum Hydrocarbons (PHC) - Water (238)
NA-TM-1112, NA-TP-2100; modified from CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD and EPA 3511
GC/FID - EXTRACTION
F2: C10-C16
F3: C16-C34
F4: C34-C50

Water (Organic)
Phenols - Water (059)
VA-TM-1101, VA-TP-2113; modified from BC MOE LABORATORY MANUAL and EPA 3510C and EPA 8270D
GC/MS - EXTRACTION
2-Chlorophenol
2,3-Dichlorophenol

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2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4,5-Trichlorophenol
2,4,6-trichlorophenol
2,6-Dichlorophenol
3-Chlorophenol
3,4-Dichlorophenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
4-Chloro-3-methyl phenol
4-Chlorophenol
m-Cresol
o-Cresol
p-Cresol
Pentachlorophenol
Phenol

Water (Organic)
Polycyclic Aromatic Hydrocarbons (PAH) - Water (237)
NA-TM-1112, VA-TP-2128; modified from EPA 3511 and EPA 8270D
GC/MS - EXTRACTION
1-Methylnaphthalene
2-Methylnaphthalene
Acenaphthene
Acenaphthylene
Acridine
Anthracene
Benzo (a) anthracene
Benzo (a) pyrene
Benzo(b,j)fluoranthene
Benzo (g,h,i) perylene
Benzo (k) fluoranthene
Chrysene
Dibenzo (a,h) anthracene
Fluoranthene
Fluorene
Indeno (1,2,3 - cd) pyrene
Naphthalene
Phenanthrene
Pyrene
Quinoline

Water (Organic)
Resin and Fatty Acids - Water (212)
VA-TM-1105, VA-TP-2114; modified from EPA 3510C and EPA 8270D
GC/MS/LIQUID-LIQUID EXTRACTION
12-Chlorodehydroabietic acid
14-Chlorodehydroabietic acid
Abietic acid

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Arachidic acid
Behenic acid
Dehydroabietic acid
Dichlorodehydroabietic acid
Isopimaric and Palustric Acid
Lauric acid
Levopimaric acid
Lignoceric acid
Linoleic acid
Linolenic acid
Myristic acid
Neoabietic acid
Oleic acid
Palmitic acid
Pimaric acid
Sandaracopimaric acid
Stearic acid

Water (Organic)
Total Polychlorinated Biphenyls (PCB) - Water (115)
VA-TM-1115, VA-TP-2116; modified from EPA 3510C and EPA 3620C and EPA 3660B and EPA 3665A and EPA 8082A
GC/ECD - EXTRACTION
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
PCB-1016
PCB-1221
PCB-1232
PCB-1262
PCB-1268
Total PCB

Water (Organic)
Volatile Hydrocarbons (VH) - Water (197)
NA-TM-1102; modified from BC MOE LABORATORY MANUAL and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD and EPA 5021A
GC/FID - HEADSPACE
F1: C6-C10
Volatile Hyrocarbons (VH): C6-C10

Water (Organic)
Volatile Organic Compounds (VOC) - Water (196)
NA-TM-1102, NA-TP-2102; modified from EPA 5021A and EPA 8260C
GC/MS - HEADSPACE
1,1-Dichloroethane
1,1-Dichloroethylene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,2,4-Trimethylbenzene

1,3-Dichlorobenzene
1,3,5-Trimethylbenzene
1,4-Dichlorobenzene
4-Isopropyltoluene
Acetone (2-Propanone)
Benzene
Bromodichloromethane
Bromoform
Carbon Tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Cumene (Isopropylbenzene)
Dichloromethane
Ethylbenzene
Ethylene Dibromide
m/p-xylene
Methyl ethyl ketone
Methyl isobutyl ketone
Methyl t-butyl ether
n-Propylbenzene
Napthalene
o-xylene
Styrene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane
Vinyl Chloride

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Appendix B

ALS Laboratory Group – Environmental Division (Canada) National Quality Manual

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ALS Canada Environmental
Life Sciences Division
National Quality Manual

National Authorizations

Authorized By: Linda Neimor
National Quality Manager, Canada
Date: October 2, 2018

Authorized By: Mark Hugdahl
Technical Director, Canada
Date: October 2, 2018

Local Authorization

____
Laboratory Location

Authorized By: ______________________________ Effective Date: ____________________
Laboratory Manager

TABLE OF CONTENTS

1.0 SCOPE

This Quality Manual describes the Quality Management System operated by the ALS Canada Environmental locations. Where appropriate, it refers to other documents for additional information. Throughout this manual, whenever ALS is used alone, it refers to the ALS Environmental locations in Canada.

The policies and procedures described in this manual comply with ISO/IEC 17025:2017 and ISO/IEC 17025:2005. Maintaining compliance to both versions of the Standard is necessary until all ALS locations and their Accrediting Bodies have transitioned to the 2017 version.

In addition, the policies in this manual comply with the requirements of clients, of ALS corporate goals, and of the current and applicable accreditation bodies and recognition agencies.

2.0 LOCATIONS, ACCREDITATIONS AND RECOGNITIONS

ALS operates several environmental testing laboratories across Canada. Addresses and contact information are available by following the location links at our web site: www.alsglobal.com.

Locations within the ALS Canada network hold accreditations for all routinely offered tests from various agencies as listed on their scopes of accreditation, and/or hold certifications or licenses provided by regional regulators, as appropriate to their fields of testing, client requirements, and geographic sectors. For example, the requirements of the following agencies and programs are currently relevant to specific locations and tests offered by ALS Canada.

- The Canadian Association for Laboratory Accreditation (CALA).
- Perry Johnson Laboratory Accreditation (PJLA).
- Quebec Accreditation Program for Analytical Laboratories (PALA).
- The NELAC Institute (TNI).
- The USA Department of Defense (DOD).
- British Columbia Enhanced Water Quality Assurance Program (EWQA).
- Ontario Safe Drinking Water ACT (OSDWA).

Current scopes and certificates for each location are publically available at www.alsglobal.com under the Environmental Downloads section. They are also available from ALS Account Managers or from the Quality Department on request. The scopes and certificates contain details on the accredited tests in each ALS locations as well as the Standard of compliance and expiry date.

The Quality Department ensures the website information is current by providing verified updates to the National Quality Manager within 48 hours of receiving the update.

3.0 TERMS AND DEFINITIONS

Refer to NA-FM-0001a Definitions of Key Terms for details.

The terms and definitions relevant to the national quality management system have been standardized and are described in a national document.

4.1 ORGANIZATION AND RESPONSIBLITIES

4.1.1 ALS is a global laboratory organization which is solely owned by the Australian publicly traded company ALS Limited. In Canada, ALS operates environmental testing laboratories under the legal name ALS Canada Ltd., and the general business name ALS Environmental.

ALS Canada provincial business registrations are maintained on the network at N:\Life Sciences\Environmental\QA\ALS Canada Business Registrations.

ALS offers the following testing services through our Environmental lab network:

- Inorganic Analysis (including Metals).
- Organic Analysis.
- Pesticide and Herbicide Analysis.
- Dioxin Testing.
- Toxicological Testing.
- Biological Examination Analysis.
- Microbiological Testing.
- Industrial Hygiene Testing.

Matrices tested include drinking water, ground and surface water, effluent, soil, sediment, solid waste, air, food and biota, including vegetation, animal, and fish tissue.

ALS Canada clients include private individuals, consultants, government, and industry.

4.1.2 ALS accepts the responsibility to carry out its testing activities in such a way as to meet the requirements of clients, regulatory authorities, ISO/IEC 17025:2005, ISO/IEC 17025:2017, and organizations providing accreditation and recognition relevant to each location, including the program requirements of CALA, PJLA, PALA, TNI, and the US DOD.

Cases of voluntary or involuntary loss of accreditation or needed recognitions are resolved by evaluating the impact to customers and taking appropriate action. Such actions may include subcontracting (refer to section 4.5), or analysis by another accredited test method.

To ensure the terms and conditions of accrediting body publicity policies are met, all publications or advertisements that refer to accreditation, proficiency testing performance, or compliance to regulations are reviewed prior to release by the Technical Director and/or the National Quality Manager.

4.1.3 This Quality Manual covers the laboratory management system for work carried out in the ALS Environmental permanent facilities and associated mobile facilities in Canada.

ALS locations do not differentiate between accredited and non-accredited testing activities. The Quality Management System described in this document applies to all testing activities performed by ALS.

4.1.4 The responsibilities of key corporate personnel that have an involvement and influence on testing activities have been defined to identify potential conflicts of interest. Refer to the Organization and Management Structure in section 4.1.5.

4.1.5 ALS has the following organizational practices:

a) Managerial and technical personnel have the authority and resources needed to carry out the duties assigned to them. Such duties include the implementation, maintenance, and improvement of the management system, and where applicable, the identification of departures from the management system or procedures for conducting tests. Managerial personnel also have the ability to initiate actions to prevent or minimize such departures. Refer to Organization and Management Structure below.

b) Arrangements are in place to ensure management and personnel are free from undue internal and external commercial, financial, and other pressures and influences that may adversely affect the quality of their work. Refer to section 5.2.1 for details on the ALS Code of Conduct Policy.

c) Policies and procedures are in place to ensure the protection of customers' confidential information and proprietary rights. Refer to policy objectives in section 4.2 and section 5.2.1 for details on the Code of Conduct Policy.

d) Policies and procedures are in place to avoid involvement in activities that would diminish confidence in the competence, impartiality, judgment or operational integrity of an ALS Laboratory or its staff. Refer to section 5.2.1 for the Code of Conduct and Data Integrity Policies.

e) The organizational and management structure is well defined, including the relationships between quality management, technical operations and support services. Refer to Organization and Management Structure below. Organizational charts are available from the Human Resources Department on request.

f) Responsibilities, authorities and interrelationships are specified for all personnel who manage, perform or verify work affecting the quality of tests. Refer to Organization and Management Structure below.

g) Adequate supervision is provided to all staff and trainees by persons familiar with test methods and procedures, the purposes of these tests and the assessment of test results. Refer to Organization and Management Structure below, and section 5.2.

h) Senior management has overall responsibility for the technical operations and provision of resources needed to ensure the quality of laboratory operations. Refer to Organization and Management Structure below.

i) The National Quality Manager has defined responsibility and authority for ensuring that the management system related to quality is maintained, implemented, improved, and followed at all times. This individual ensures that personnel understand their contribution to the quality system, quality system tools are evaluated objectively, and the effectiveness of the quality system is communicated to all levels of the organization. This individual is independent from laboratory operations and has direct access to the highest levels of ALS management. Refer to Organization and Management Structure below.

j) Personnel are appointed to substitute as needed in the absence of key managerial personnel. Such substitutions must be flexible due to the variety of demands on individuals. The Organization and Management Structure table below summarizes routine practices. Substitution details are available at each location where needed.

k) Personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the management system – refer to section 5.2 for additional information.

ORGANIZATION AND MANAGEMENT STRUCTURE

The management system in Canada is divided between laboratory specific, regional and national functions. An appropriate number of managerial positions support the management system. The responsibility, authority and interrelationships of key positions are defined and outlined in the table below.

Alternates are assigned by job-function and therefore staff in each location know who the alternate is during any absence. In addition, individuals are identified as alternates in email out-of-office messages for both internal and external emails, to ensure continuous availability of responsible staff.

Corporate cross-divisional roles (not specifically listed below) include human resources, finance, accounting, compliance and management of information technology.

KEY ENVIRONMENTAL DIVISION ROLES AND ALTERNATES

Title	Role and Alternate Where Applicable
General Manager, Life Sciences, Americas	Responsibility for and authority over operations at all locations within North and South America. Reports to the ALS CEO.
Regional Operations Directors	Responsibility for and authority over operations within designated regions (Western Canada, the Prairies, Eastern Canada). Reports to the General Manager. Fills other regional roles as needed during absences.
Regional Business Development Managers	Responsibility for oversight and management of the sales and marketing division within designated regions (Western Canada, the Prairies and Eastern Canada). Reports to the Regional Operations Directors.
North America Purchasing Department	Responsibility for oversight and operation of the purchasing system. Reports to the Director of Finance, North America.
Technical Director, Canada (TD)	Responsibility for managing a group of national technical specialists, for oversight and management of technology and best practices, and for ALS Canada nationally harmonized test methods and the ALS Canada Quality System. Reports to the General Manager. Fills NQM role as needed.
National Quality Manager, Canada (NQM)	Responsibility for managing the ALS Canada Quality Department staff and for overseeing the development, documentation, implementation, and oversight of the harmonized ALS Canada Quality System. Reports to the TD. Fills the TD role for quality issues as designated. Fills local QA roles as needed.
Laboratory Managers	Responsibility for and authority over operations for a single location, including the provision of resources needed to ensure the quality and compliance of laboratory operations. Reports to a Regional Operations Director. Fills other local managerial and supervisory roles as needed.
Laboratory Dept. Managers, Client Services Managers, Supervisors, and Team Leaders	Responsibility for and authority over selected operations and for providing adequate supervision of a department or section within a single location. Reports to the Laboratory Manager or Supervisor. Fills local management and supervisory roles as designated.
Quality Systems Coordinators (QA)	Responsibility for the organization, implementation, maintenance and monitoring of the nationally defined quality management system in one or more locations. Reports to the NQM for quality-related duties. Fills the NQM role as designated.
Analysts, Support Staff, Administrative Staff, Sales and Marketing Staff	Responsibility for and authority over assigned work. Reports to Department Manager or Supervisor. May be designated to fill local Supervisor or Manager roles.

4.1.6 Senior management communicates the ongoing effectiveness of the management system to all staff throughout the network. This is primarily accomplished through staff meetings and reports communicated as appropriate to all levels of the organization. Management system goals related to quality are developed by the management team and communicated to all affected division personnel. The status of management system is reported monthly to national, divisional and location management through National Quality Reports. National

Quality Reports are posted on the ALS network and are accessible to all staff at: N:\Life Sciences\Environmental\QA\National Quality Reports and Template.

4.1.7 For TNI/DOD accreditations:

The individuals identified as technical managers in the program applications are members of staff that exercise day-to-day supervision of laboratory operations for the applicable fields of accreditation and reporting of results.

They are experienced in the applicable fields, and monitor the standards of performance and the validity of the analyses to ensure reliable data. They will not fill the technical manager role at more than one laboratory location without authorization from the primary Accreditation Body.

If an individual identified as a technical manager will be absent for a period of time exceeding fifteen consecutive calendar days, they will designate another staff member meeting the qualifications to temporarily perform their function. If their absence exceeds thirty-five consecutive calendar days, the primary Accreditation Body must be notified in writing.

4.2 MANAGEMENT SYSTEM

4.2.1 The ALS management system is appropriate to the type, range, and volume of environmental testing activities undertaken at each location. Policies, systems, programs, procedures, and instructions are documented to the degree necessary to assure the quality of test results. ALS ensures all staff understands the quality management system and that all required documentation is available to and implemented by staff.

4.2.2 MANAGEMENT SYSTEM POLICIES, POLICY STATEMENT AND OBJECTIVES

ALS management is committed to good professional practice, and to providing a superior level of service and quality in its testing activities that exceeds the industry norm. Our management system is designed to comply with the requirements of ISO/IEC 17025:2005, ISO/IEC 17025:2017, the program requirements of all applicable accrediting bodies, ALS corporate goals, and to satisfy the needs of clients, regulatory authorities, and organizations providing recognition. All staff are required to be familiar with ALS quality system documentation and to implement its policies and procedures in their work. ALS management is committed to complying with these policies and to continually improve the effectiveness of the management system.

This policy statement and the entire Quality Manual are issued under the authority of senior management in Canada.

The policy objectives of the management system are listed below. Their implementation and effectiveness is evaluated during management reviews:

- ALS protects its customers' confidential information and proprietary rights. We require all employees to review and sign the Code of Conduct agreement that communicates the ALS expectations for employee conduct, including the confidentiality policy (refer to section 5.2.1). The electronic storage of information is protected by a national computer network protection system (refer to section 5.1). Test results are protected during communication and transmission by ensuring only the correct individual receives results, and by identifying transmissions as confidential (refer to section 5.10).

- ALS employees avoid involvement in activities that would diminish confidence in their competence, impartiality, judgement or operational integrity by complying with the ALS Code of Conduct agreement and the Data Integrity Policy (refer to section 5.2.1).
- The quality policy statement heading this section is issued under the authority of senior management. The policy statement includes measurable objectives that are monitored through operation of the quality management system, as identified in the following points.
- Involuntary loss of accreditation results in an evaluation of the impact to the customer and determination of appropriate action (refer to section 4.1.2).
- Procedures pertaining to the quality management system and testing activities are documented and controlled to ensure the most current work instructions are available to staff. Responsibilities are defined for monitoring documents of both internal and external origin for currency and continued suitability. Updates to external documents are reviewed to determine if changes to internal processes are needed (refer to section 4.3).
- Appropriate personnel are involved with the provision of quotations and contracts to the degree necessary to understand our clients' needs, to determine if a location can manage projected workloads, to identify the correct test methods to be used, and to maintain appropriate communications with the client during testing. Records of client communications are maintained and all changes to work plans are communicated to those involved (refer to section 4.4).
- Tests are subcontracted to laboratories that have demonstrated competency for the targeted test in a manner acceptable to the applicable accreditation and recognition agencies, and that meet the customers testing needs and ALS corporate compliance requirements (refer to section 4.5).
- Suppliers of goods and services are pre-approved using national protocols where they affect the quality of test results. The national purchasing system provides control over selection and purchasing of goods and services, while systems for reception, storage, and handling of supplies ensure we receive what was ordered, that appropriate storage is provided, and that records of verification are maintained where needed (refer to section 4.6).
- Complaints, whether received by direct communication or during survey activities, are managed and resolved. Records are maintained of the complaint, including discussions with the client, and its resolution (refer to section 4.8).
- When any of our services fail to conform to ALS policies or procedures or to the requirements of our customer, a nonconformance is recorded. Procedures define the responsibilities and authorities for handling nonconformances, including documentation, work stoppage, work resumption, and for evaluating the significance of the nonconformance. Correction, evaluation, and customer notification are initiated where applicable (refer to section 4.9).
- Cause analysis is performed where nonconforming work is identified and where corrective action is needed. Corrective actions that will prevent recurrence are selected and implemented as appropriate to the magnitude and risk of the problem. Procedures describe documentation requirements, national and local monitoring, and the provision of additional audits as needed (refer to section 4.11).

- New employees receive an orientation and job-specific training. Training needs are reviewed on an on-going and as-needed basis to ensure cross-training is provided and that work can be reassigned when needed. Longer term training plans are developed during annual performance evaluations. The effectiveness of training actions is evaluated using direct observation and monitoring of quality system tools. Additional training can be requested by anyone at any time for LIMS, quality systems or specific technical topics (refer to section 5.2).
- ALS Quality Control practices monitor the validity of tests performed by its laboratories. Technical records are maintained to allow evaluation and interpretation of original test conditions and test results. Technical records are organized to support test result, inter-parameter, and test report validation by qualified, authorized, and independent individuals (refer to section 5.9).

4.2.3 Evidence of commitment to the development and implementation of the management system and to its continual improvement is available in the procedures and records referred to throughout this document, and include the approval and implementation of the systems described in this manual.

4.2.4 ALS senior management's communication of the importance of meeting customer, statutory and regulatory requirements is provided in various ways such as during staff meetings as described in section 4.1.6, through employment policies, business goals, and the training program (refer to section 5.2). In addition, goals set during management reviews (as described in section 4.15), and various planning meetings are communicated as appropriate.

4.2.5 This Quality Manual includes or references relevant support and technical procedures and outlines the structure of documentation used in the management system.

4.2.6 Roles and responsibilities of technical and quality management staff are summarized in section 4.1.5. Responsibilities for ensuring compliance with International Standards and the program requirements of accreditation and recognition agencies are defined as:

- The Technical Director is responsible for the direction and technical authorization of the national quality management system.
- The National Quality Manager is responsible for building a national quality management system in compliance with the current International Standards and the relevant program requirements of accrediting and recognition agencies, and for reporting on the status of national and local implementation to the management team.
- Local quality staff are responsible for implementing the national quality management system under the direction of the NQM in the locations under their responsibility, and for reporting on the status to the local Lab Manager and National Quality Manager.
- Local Lab Managers are responsible for ensuring implementation of the national quality management system in their locations, and for addressing reported deficiencies.
- Regional Directors are responsible for supporting and enforcing compliance to the national quality management system.

4.2.7 Senior management ensures the integrity of the management system is maintained when changes to the system are planned and implemented. This is achieved by assigning the planning and implementation of changes to staff that have the appropriate knowledge, training, qualifications, and authority to manage the changes, and by ensuring planned changes have adequate review and oversight by personnel who understand the implications. Planned changes to the management system are reported to and discussed with the national management team as needed, prior to authorization and implementation.

4.2.8 In some regions, authorized/qualified signatories must hold professional chemist designations in the province where the laboratory is located. This is currently applicable to testing performed under the Quebec PALA program and testing performed under the Saskatchewan MOE regulatory agency. Local Laboratory Management is responsible for meeting requirements applicable to their work.

4.3 DOCUMENT CONTROL

Refer to NA-SP-0425 Document Control for Internal and External Documents for details.

4.3.1 STRUCTURE OF MANAGEMENT SYSTEM DOCUMENTATION

ALS controls documents that form part of its quality system, including those of internal and external origins.

Internal documents are those originating within ALS Canada Environmental. Some internal documents are national in scope and are intended to be used at multiple locations. Others are local and are intended to be used at one specific location. The documentation structure is outlined below:

Document Type	Application	Origin
Quality Manual	High-level Policies	National
Support Procedure	Quality System Policies and Procedures	National or Local
Test Method	Testing Activity	National or Local
Test Procedure	Testing Activity	National or Local
Work Instruction	Testing Activity	National or Local
Form	Can Apply to Any Level of Document	National or Local
Variance	Can Apply to Any Level of Document	National or Local

In the rare case where local and national Support Procedure documents both describe similar activities or information, the local document takes precedence only when the policies specified in the national document are fulfilled as intended.

Templates for the above documents are provided to ensure consistency of technical content and presentation across the ALS Environmental Division locations. Templates are provided for documents of both national and local origin.

External documents originate from sources external to ALS. External documents that are important to the operation of our laboratories include, for example, instrument manuals, software manuals, reference methods, regulations, standards, and accrediting body policies. When external documents are used directly to perform work, supplemental internal documents will relate the additional information required by the ALS document templates.

4.3.2 DOCUMENT APPROVAL AND ISSUE

4.3.2.1 Documents used in the laboratory as part of the management system are reviewed and approved for use by authorized personnel prior to issue. These authorities are personnel with knowledge appropriate to the content of the document.

Master lists are maintained for the authorization and distribution of national documents in the common computer network drive at:

N:\Life Sciences\Environmental\QA\Documentation\National Documents.

Master Lists are also maintained for each location. They include documents from internal and external, and local and national origins that have been authorized for local use. Master Lists are available for viewing by all staff.

4.3.2.2 Authorized documents are available at all work stations where essential to the effective functioning of the laboratory.

Internal documents and any related forms are reviewed on a cycle corresponding to the internal audit schedule to ensure continuing suitability and compliance with requirements. Refer to section 4.14 for additional information regarding internal audit schedules.

External documents such as applicable regulations, reference methods, and documents issued by accrediting and recognition bodies are monitored by individuals responsible for the work. Changes to internal processes and documentation are identified and occur when needed to ensure continued suitability and compliance.

Invalid or obsolete documents are removed from use. The original electronic file and the original signed hard copy are transferred to clearly identified archive files and maintained as historical quality system records.

4.3.2.3 Documents generated by ALS Laboratories are uniquely identified, including:

- Document identification number and name.
- Version number.
- Header Date (date of the last change made to the version).
- Signing authorities and dates for Quality and Technical authorizations.
- Local signing authority and effective date (date the documented procedure was authorized for implementation at the location).
- Page numbering and total number of pages.

Authorizations and date conventions are simplified for forms. If it becomes necessary to amend an authorized national document for local use, procedures describe the editing process and the Technical authorization is provided by the national signing authority.

4.3.3 DOCUMENT CHANGES

4.3.3.1 Changes to internal documents are reviewed and approved by the same authorities as the original document, unless otherwise delegated. All involved in this process have access to pertinent information upon which to base their approval.

4.3.3.2 A summary of revisions is provided in each document to relate significant alterations or new text.

4.3.3.3 Where hand-written amendments are made pending re-issue of the documents, the following apply:

- Hand written amendments are authorized by both quality and technical staff, as per the original document.
- Amendments are clearly legible, initialed and dated.
- Formally re-issue the document no later than the next scheduled internal audit.

Hand written amendments are not made to national documents.

4.3.3.4 Procedures are established to describe how changes to documents maintained in computerized systems are made and controlled.

4.4 REVIEW OF AGREEMENTS, QUOTATIONS AND CONTRACTS

Refer to NA-SP-0650 Quotations and Contracts, and NA-SP-0651 Credit Policy and Procedure for details.

4.4.1 Agreements, quotations and contracts are reviewed to ensure understanding of defined and documented requirements. The customer’s status is evaluated and Information is shared to ensure the location has the capability, resource availability, and the appropriate test methods to meet applicable requirements. Differences that occur between a quotation and the final contract are resolved prior to commencing work.

4.4.2 Records of reviews, including communications and significant changes to the customer’s requirements or the laboratory’s capabilities are maintained.

For routine and simple tasks, the date and initials of the laboratory staff responsible for carrying out the work is an adequate record of review. For repetitive routine tasks, a review at the initial inquiry stage is adequate as long as the requirements do not change. For new or complex testing requirements, a more comprehensive record is maintained.

Records are also maintained of all pertinent discussions with clients during the life span of the contracted work.

4.4.3 The reviews performed include reviews of tests subcontracted by ALS. Refer to section 4.5.

4.4.4 The customer is informed of any proposed deviation from the contract.

4.4.5 If changes are made during the contract, the new requirements are subject to the same review process as the original contract. Any amendments are communicated to all affected personnel. If, due to unforeseen circumstances, the laboratory is unable to comply with a condition of the contract (e.g. turnaround time, equipment failure), the client is notified as soon as possible and contingency plans are developed.

4.5 SUBCONTRACTING TESTS

Refer to NA-SP-0052 Internal and External Subcontracting and Network Notifications of Test Status Changes for details.

4.5.1 Testing is subcontracted to another ALS location or external organization when it cannot be carried out at the receiving location. ALS has policies and procedures that govern the qualification of subcontract labs and the handling and transfer of subcontracted samples. ALS selects subcontractors through a qualification process that includes an evaluation of the test method, detection limits, accreditation status, agreement to notify of status changes, and corporate insurance policy compliance.

When subcontracting samples for accredited tests, ALS chooses subcontract labs that are accredited to either ISO/IEC 17025:2005 or ISO/IEC 17025:2017 during the transition phase, for the specific tests by agencies recognized by the applicable accrediting body, and who also meet the client and corporate ALS criteria. Labs holding accreditation by a recognized accrediting body for the tests in question are given first consideration when subcontracting non-accredited tests whenever the client and corporate ALS requirements are also fulfilled. If an accredited lab is unavailable, impractical or does not meet testing or corporate criteria, ALS will choose laboratories that at minimum fulfill the other components of the qualification process.

4.5.2 The client is notified in writing of subcontract arrangements. Client written approval is obtained whenever possible, and records of approval are kept. When notified of subcontracting by quote or contract, the submission of samples is deemed as acceptance of the subcontract laboratory.

4.5.3 Clients or regulatory authorities sometimes specify the subcontractor to be used. The ALS qualification process is optional in these cases as described in the support procedure.

4.5.4 ALS laboratories maintain lists of pre-approved subcontract lab tests and records of the qualifications.

4.6 PURCHASING AND HANDLING SUPPLIES AND SERVICES

Refer to NA-SP-0050 Purchasing and Vendor Approval for details.

4.6.1 ALS controls the procurement of supplies and services where there is a potential impact to the quality of test results. Documented procedures exist for the purchasing, reception, and storage of materials relevant to the tests performed at each location.

4.6.2 Supplies that affect the quality of test results are not used until they are inspected to verify the received items conform to the specifications or requirements as ordered. Upon receipt, supplies are compared to the packing slip to establish the order was filled correctly. The packing slip is initialed and dated as a record of the receipt and verification.

Certificates of traceability and/or analysis are maintained for certified supplies such as certified reference materials and standards, stock cultures and other consumables where specifications are critical. When additional verification is needed such as testing, procedures at the location describe the testing performed and records maintained.

Critical supplies and their storage conditions are specified in test methods wherever needed to protect the quality of test results.

4.6.3 Purchasing requisitions are reviewed for technical content at each location to ensure required specifications are met. Requisitions are further reviewed by purchasing staff to ensure correctness, and to determine the most appropriate supplier.

4.6.4 ALS works closely with vendors of critical supplies to ensure they understand our requirements and specifications, and can consistently meet them. The ALS Purchasing Department maintains the purchasing system that limits access to only approved supplies from approved vendors for North American ALS labs. A list of current approved vendors is available from the Purchasing Department upon request. Approved supplies and vendors are those that have been demonstrated through validations and through experience to be fit for specific usage. In cases where a supply or vendor fails to consistently meet our quality specifications, corrective action is taken that is relevant to the event. Corrective action can include for example, national notification to user labs, identification of replacement supplies and blocking the questionable supply in the purchasing system to prevent future orders.

4.7 SERVICE TO THE CUSTOMER

4.7.1 ALS cooperates closely with its customers to ensure their testing needs are understood, and allows them reasonable access to relevant areas of the laboratories to audit the management system or to witness test work being undertaken on their behalf.

ALS assists customers to develop audit objectives when appropriate. An ALS staff member reviews the External Auditor Confidentiality Agreement with the client and invites them to sign it. An ALS staff member accompanies any client while on-site and ensures steps are taken to protect the confidentiality of other customers' information in accordance with the ALS ethics, confidentiality, and privacy policies (refer to 5.2.1). ALS records and addresses all customer audit findings. Also refer to section 4.14 regarding external audits.

ALS has assigned staff the task of ensuring good communication with customers regarding technical issues and the status of testing being conducted on their behalf. Customers are informed of delays or deviations in the conduct of their tests. Communications with customers are documented as needed to ensure continuity of service.

4.7.2 Periodically, ALS prepares and distributes or commissions surveys to its customers. The purpose of these surveys is to evaluate services, to ensure ALS continues to meet clients' needs and to identify areas for improvement. Copies are maintained at: N:\Life Sciences\Environmental\QA\Client Surveys. The surveys are evaluated by national and regional management teams and are used to define initiatives for improvements. In addition to various senior management planning meetings, survey results are communicated during Management Reviews (refer to section 4.15).

4.7.3 The Technical Director and National Quality Manager maintain summaries of ALS Quality System and Quality Control Protocols to provide customers with an understanding of ALS practices. The summaries are provided in both Word and PDF format. The Word format text is intended to be copied into larger documents while the PDF file can be emailed directly to customers. Copies are accessed on SharePoint.

4.8 COMPLAINTS

Refer to NA-SP-0125 CARS and PARs for details.

ALS is committed to providing a superior level of service to its customers. As a result, every complaint received from customers or other parties, whether received by direct communication or during survey activities, is important and receives follow-up.

To ensure adequate oversight and resolution, all complaints received by ALS are initially recorded as nonconformances, and follow the usual investigation, resolution, and client notification processes.

Information on the ALS process for handling complaints is readily provided to interested parties on request.

4.9 CONTROL OF NONCONFORMANCES

Refer to NA-SP-0125 CARS and PARs for details.

When any work conducted by ALS does not conform to a requirement, including noncompliance with ALS policies and procedures or the requirements of our customers, the nonconformance is recorded and reviewed by an appropriate authority.

Nonconformance procedures define responsibilities and authorities for:

- Halting work and withholding reports where appropriate.
- The evaluation of the significance (risk) of the nonconformance.
- Ensuring immediate correction / remedial actions.
- Customer notification where applicable.
- Authorizing the resumption of work.

Where the evaluation indicates it is appropriate to prevent recurrence, root cause analysis and corrective action are implemented – refer to section 4.11.

Single event data quality objective failures or other isolated occurrences during testing activities are initially recorded on a test method nonconformance record which includes corrective action or technical justification and authorization. When recurrence is observed, the issue is transferred to the LIMS System for Corrective Action Reports (CARs).

Nonconformances identified during audits and assessments are recorded in reports that are used to track the issues through the steps listed above and to resolution. Any issues that require immediate action are entered into the LIMS CAR system – refer to section 4.14.

All other sources of nonconformance are recorded directly into the LIMS CAR system.

4.10 IMPROVEMENT

Management’s commitment to continuously improving the effectiveness of the management system is demonstrated by the use of various management system tools to identify areas of needed improvement. Regular evaluations of each of the following are used to identify areas for improvement: internal and external audits, corrective and preventive action reports, management reviews and various management reports and meetings, client feedback, proficiency test results, reviews of test method performance and data quality objectives, client surveys, and input from personnel. Documentation and follow-up is defined in the Quality Manual sections specific to these functions and activities.

4.11 CORRECTIVE ACTION

Refer to NA-SP-0125 CARS and PARs for details.

Appropriate corrective actions are evaluated whenever investigation of a nonconformance indicates prevention of recurrence is needed. Responsibilities and authorities are defined for implementing and documenting corrective actions based on an analysis of the causes and identification of the root cause where possible.

Corrective actions that are most likely to prevent recurrence of the nonconformance are initiated, as appropriate to the magnitude and risk of the problem. Actions taken are monitored for effectiveness where appropriate.

When a serious risk is identified, or when otherwise deemed appropriate, additional audits are performed when the nonconformance casts doubt on compliance with ALS policies and procedures or compliance with regulations or with accreditation requirements.

4.12 PREVENTIVE ACTION

Refer to NA-SP-0125 CARS and PARs for details.

Needed improvements and potential sources of nonconformance for technical and management systems are identified from various sources (see also section 4.10).

When improvement opportunities are identified or when preventive actions are needed, action plans are developed, implemented and monitored to reduce the likelihood of a nonconformance. The investigation and record keeping system is the same as for nonconformance and corrective action. Refer to sections 4.9 and 4.11.

4.13 CONTROL OF RECORDS

Refer to NA-SP-0175 Data Validation of Test Data, NA-SP-0252 Protection and Storage of Sample Testing Records, and NA-SP-0850 Electronic Data Control and Security for details.

4.13.1 General

4.13.1.1 ALS controls records through defined procedures for identifying, collecting, indexing, accessing, filing, storing, maintaining and disposing of quality and technical records.

Quality records include but are not limited to reports from site assessments, customer audits, internal audits, management reviews, corrective actions, preventive actions, proficiency testing reports, initial method validations, and revalidations. Storage of quality records is described in the SOPs that describe these programs.

Refer to 4.13.2 for information regarding technical records.

4.13.1.2 All records are legible, readily retrievable and stored in an environment that protects them from damage or deterioration for a minimum of five years, unless regulatory or contractual obligations dictate a longer retention period. Records may be recorded and stored on paper or using an electronic medium.

4.13.1.3 All records are held secure and in confidence, in compliance with policies for confidentiality and non-disclosure - refer to section 5.2.

4.13.1.4 Procedures exist for the back-up and protection of records stored electronically, and to prevent unauthorized access to or amendment of these records.

4.13.1.5 For records related to TNI / DOD accreditation:

When accreditation is transferred in the case of new ownership or a change in legal status, quality and technical records pertaining to accreditation will be maintained for a minimum of five years and will be subject to inspection by the accrediting authority without prior notification to the lab.

Where required by the accrediting authority, and in the event of a transfer of ownership or closure, the lab will ensure records of analysis are maintained or transferred according to its customers instructions. This information will be collected from customers when needed. In cases of bankruptcy, all regulatory and legal requirements concerning laboratory records will be followed.

4.13.2 Technical Records

4.13.2.1 Technical records include all original observations and derived data recorded at the time they are made. Technical records include sufficient information to establish an audit trail, such as equipment records, calibration records, method validation records, reagent and standard preparation records, unique sample preparation and analysis instructions and records, staff records, copies of each test report issued, and the identities of the individuals responsible for performing each test and for checking results. Records for each test contain enough information to identify factors affecting uncertainty and to enable the test to be repeated under conditions as close as possible to the original.

4.13.2.2 All observations, data and calculations are recorded at the time they are made in a manner identifiable to the specific task.

4.13.2.3 When a mistake is identified in a hard copy record, the original record is left legible with a line drawn through it, and hand-written corrections are recorded alongside, together with the date and initials of the person making the change. Where not intuitive, all reasons for corrections are documented in the pertinent analytical records. Data changes in LIMS are tracked using a Good Automated Laboratory Practice (GALP) function that includes the identity of the individual and the reason for the modification.

4.14 INTERNAL AUDITS

Refer to NA-SP-0400 Audits – Internal and External for details.

4.14.1 Internal audits are performed at each facility following pre-determined schedules and procedures to ensure operations comply with the requirements of the management system, the program requirements of all applicable accrediting and recognition bodies, ISO/IEC 17025:2005, and ISO/IEC17025:2017. Audits are managed by the Quality Department.

Management system audits are managed nationally and scheduled annually. Schedules and records are maintained in network folders. Technical audits of testing activities are coordinated locally. They are scheduled on a cycle that complies with accreditation program requirements. Test method revalidation and document review are part of the ALS audit protocol. Schedules and records are maintained for all audits.

Audit schedules record the accreditation program relevant to each laboratory and test to ensure program-specific requirements are included in each audit.

Audits are coordinated and conducted by individuals who have received training on audit objectives and techniques and who are independent of the activity being audited wherever possible.

Technical audits can require a group effort to ensure a technical review is performed that will identify needed improvements and ensure implementation of best practices. Draft audit reports and supporting documents and data are reviewed and released by QA to ensure impartiality.

4.14.2 ALS takes timely corrective action when audit findings cast doubt on the effectiveness of operations or the validity of test results. ALS notifies customers in writing if investigations show test results may have been adversely affected, as soon as the scope and impact of the event is understood.

4.14.3 Records of internal audits performed, identified nonconformances, root cause analysis and where needed, selection of corrective actions that will prevent recurrence are recorded in audit reports. A LIMS CAR is issued for any nonconformances that require immediate action.

4.14.4 Follow-up audits verify the implementation and effectiveness of corrective actions taken due to audit findings.

4.15 MANAGEMENT REVIEWS

Refer to NA-SP-0401 Management Review for details.

4.15.1 At least annually, Management conducts a review to ensure the management system is effective, continues to be suitable for its operations, and to identify necessary changes or improvements. Senior management is included in the review process for all locations.

The review may be a series of events or meetings that percolate up through the management structure that are summarized at year-end, or may be an annual event or meeting. Determining the format and setting the schedule is the responsibility of the local Laboratory Manager. The schedule is maintained and the review facilitated by Quality staff.

The intent is to evaluate the status and adequacy of national and local policies and systems by examining the following items for the time period between reviews:

- Status of actions from previous management reviews.
- Changes in internal and external issues that are relevant to the laboratory.
- Fulfillment of objectives.
- Suitability of the Quality Policy Statement, policy objectives, and procedures.
- Reports from managers and supervisors, and feedback from personnel.
- Outcomes of internal and external audits and assessments.
- Corrective and preventive action reports.
- Proficiency testing results and other interlaboratory comparisons.
- Changes in the volume and type of work or in the range of laboratory activities.
- Adequacy of resources.
- Complaints and other client feedback from all sources including surveys.
- Effectiveness of any implemented improvements.
- Results of risk identification.

- Outcomes of the assurance of the validity of results.
- Recommendations for improvement.
- Other relevant topics such as management objectives related in lab metrics and key performance indicators or other monitoring activities, new tests under development, new recognition programs being sought, staff training, etc.

4.15.2 Findings from the reviews and identified decisions and actions are recorded and carried out in an appropriate and agreed upon timeframe.

4.15.3 In addition, the Quality Department provides status reports each month to local and senior management. These reports include reviews of internal and external audits and assessments, proficiency testing programs, nonconformances, corrective and preventive actions, training initiatives, and any other information needed to inform management of the status of the quality system.

4.16 ACTIONS TO ADDRESS RISKS AND OPPORTUNITES

Refer to ALS Limited Risk Management Policy and Framework CAR-GL-GRP-POL-007 and Risk Appetite and Tolerance Statement CAR-GL-POL-011 for details.

ALS views risk management as a key component of its corporate governance responsibilities and an essential process in achieving and mandating a viable organization. ALS is committed to enterprise-wide risk management to ensure its corporate governance responsibilities are met and its strategic goals are realized.

Risk is defined at ALS as the effect of uncertainty on objectives. Objectives for the organization have different attributes and aspects, such as financial, health and safety, and environmental goals, and are considered at different levels, such as enterprise-wide, operational, and project levels. ALS interprets risk as anything that could impact meeting its corporate strategic objectives, and believes risks can provide positive opportunities as well as having negative impacts.

Tools and reporting mechanisms vary from immediate action and immediate notification of the ALS CEO in extreme cases, to management through routine procedures such as Corrective Action Reports, audits, and routine reporting mechanisms for lower risk situations.

Regardless of the mechanism used, the policies and tools provide a framework for categorizing, assessing, analyzing, and addressing risk, as well as monitoring and reviewing actions taken. Roles and responsibilities are defined in the relevant procedures.

5.0 TECHNICAL PROTOCOLS

5.1 COMPUTER SYSTEM MANAGEMENT

Refer to ALS Limited Data and IT Usage Policy IT-GL-GRP-POL-001, NA-SP-0850 Electronic Data Control and Security and NA-SP-0150 Creation and Validation of LIMS Products for details.

A network of computers and information management systems interface specific workstations into Local Area Networks (LANs) that are coordinated and managed by the North American IT Group under the authority of the Chief Information Officer.

Security is achieved through a combination of passwords, permissions, firewalls and Virtual Private Network (VPN) systems.

System access and monitoring for system failures, data back-up, archival, protection and retrieval are strictly controlled.

Software development in North America is performed under the authority of the General Manager, Life Sciences. Development and changes to the Laboratory Information Management System (LIMS), is controlled by the LIMS Steering Committee. Extensive testing is performed prior to introduction of changes to the operational modules of LIMS.

Test data is managed in LIMS through product codes that can only be created by specifically delegated individuals. Specifications for new codes and changes to existing codes are documented. New codes are fully validated prior to release from sample login through to data reporting to verify the correct functionality of all components including data calculations and data transfers.

5.2 PERSONNEL

Refer to the Orientation Training Record FRM 710, the ALS Code of Conduct HR-GL-GRP-POL-001, the Data Integrity Policy NA-FM-200a and the Whistleblower Policy ADM 205 for details.

5.2.1 ALS ensures the competence of all personnel who operate specific equipment, perform specific tests, evaluate procedures, sign test reports, and supervise or manage lab operations, and to evaluate the significance of deviations. Staff are qualified on the basis of education, training, experience, and/or demonstrated skills necessary for performing assigned functions. Staff undergoing training are supervised by assigned trainers.

Position descriptions are used to communicate to personnel their duties, responsibilities and authorities. Position descriptions specify the qualifications for each position, and are generally a combination of education and experience appropriate for the role. Records of educational backgrounds are maintained in personnel files.

Upon hiring, all staff are provided an orientation to safety programs, employment policies, and management system policies. Each section of the orientation is managed by appropriate staff in each location, under the authority of the local Laboratory Manager.

ALS is committed to achieving the highest standards of ethical conduct. Acceptance of employment is an implicit commitment to observe the company's standards of conduct and performance.

The Code of Conduct provides a framework for decisions and actions in relation to conduct in employment. It underpins commitment to a duty of care to all employees and to customers receiving our services. The agreement covers a wide range of topics including personal and professional behavior, conflicts of interest, gifts, confidentiality, legal compliance, and security of information, among others. The Code of Conduct is administered in Canada by the North American Human Resources Department as part of an orientation provided to newly hired staff. The orientation is provided locally under the responsibility of the local Laboratory Manager. Records are forwarded to the Human Resources (HR) Department for maintenance in secure personnel files.

The Data Integrity Policy expands on the Code of Conduct agreement regarding personal and professional behavior that directly impacts test results and information. Specific expectations are identified for ALS and its employees.

The Data Integrity Policy is administered by the National Quality Department as part of a Quality System orientation provided to newly hired staff. Quality staff ensures the original signed policies are forwarded to HR for maintenance. In addition, all employees are required to attend annual Data Integrity refresher sessions. Attendance records are maintained.

Together, these agreements ensure freedom from undue internal and external commercial, financial, and other pressures or influences that could adversely affect the quality of work. They protect customers' confidential information and the proprietary rights of ALS. They ensure avoidance of activities that would diminish confidence in the competence, impartiality, judgement, or integrity of any ALS staff.

Any breach or suspected breach of the Code of Conduct or the Data Integrity Policy can be reported to any manager, or to any HR or QA representative. In addition, ALS provides an Integrity and Compliance Helpline on SharePoint as a confidential and independent guidance and reporting service that is accessible to all staff. Any cases of theft, fraud, dishonesty, risks to impartiality, harassment, unethical behavior, and/or workplace safety hazards can be confidentially and anonymously reported to an independent party. An investigation procedure details the process and notifications. In addition, the ALS Whistleblower Policy protects staff that make honest and genuine reports from all forms of retaliation.

For activities related to DOD accreditation, any instances of inappropriate and prohibited laboratory practices must be reported to the Accrediting Body within 15 business days of discovery. Discovery includes findings of such inappropriate practices by laboratory staff or customer stakeholders. Laboratories must submit records of associated corrections taken or proposed corrective actions to their Accrediting Body within 30 business days of discovery.

5.2.2 ALS generally identifies long term training needs and plans for the provision of training to personnel during annual performance reviews, based on present and anticipated future responsibilities. The effectiveness of training is evaluated during a six-month follow-up where applicable.

Training is also undertaken at any time the need is identified, whether to ensure adequate cross-training so work can be reassigned if needed, or to update knowledge and skills. The effectiveness of as-needed training is evaluated by the assigned trainer or by the manager responsible for the work. Evaluation tools include direct observation, quality control samples, performance testing samples, technical audits, and corrective action reports.

Training is provided for every job function and may include but not be limited to quality systems, LIMS applications, management, leadership, customer service, safety, test method or equipment specific training, and issuing test reports. Staff may request additional training at any time.

The process for demonstrating analyst proficiency for specific tests is documented and complies with applicable accrediting body policies regarding training duration, content, and record keeping, where specified. On-going proficiency is monitored through using proficiency testing samples with additional training provided as needed. Analysts who predate current competency and training procedures are grandfathered into the current system.

5.2.3 Periodically, contract personnel may be hired to fulfill specific project requirements. Contract personnel are subject to the same qualifications, supervision, orientation, and training procedures as permanent staff.

5.2.4 The Human Resources Department maintains position descriptions for managerial, technical, and key support personnel. Position descriptions are used for job postings to ensure prospective employees are aware of position requirements prior to applying.

5.2.5 Records are maintained for all staff and include the relevant authorizations, educational and professional qualifications, training, skills and experience. Records include dates of authorization and confirmed competence.

5.2.5 For TNI / DOD Accreditations:

Individuals identified as Technical Managers must meet specific qualifications identified in the program documents.

5.3 ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

ALS facilities and their environmental conditions, including energy sources, lighting, and temperatures are appropriate for the correct performance of tests conducted at each location.

All instrumentation and electrical equipment used within ALS facilities must meet or exceed the relevant Canadian Standards Association (CSA) or Underwriters Laboratory (UL) requirements. Any equipment or instrumentation containing a radioactive source must meet or exceed the safety and licensing requirements specified by the Canadian Nuclear Safety Commission.

Environmental requirements necessary for the performance of specific tests are site-specific and are documented, monitored, and recorded. When such requirements are out of compliance, appropriate action is taken that may include suspension of testing where applicable, in accordance with the local documents.

Incompatible activities are separated and steps are taken to prevent cross-contamination. Refer to site-specific floor plans.

Each ALS location has procedures to ensure that access to laboratory and office areas is monitored and restricted to authorized individuals only.

Housekeeping is conducted to maintain appropriate environmental conditions within each facility.

SAFETY

ALS has an extensive safety program managed by the Corporate Compliance Department for ALS North America. The program is designed to meet corporate, federal, and regional regulations as applicable. The Safety Program includes task specific safety requirements, regular safety meetings and audits, and compliance and incident reporting mechanisms. Management and staff are responsible for implementing and adhering to the Safety Program, Safety Policies, and related procedures. Safety information is available on SharePoint.

All fire safety equipment within the ALS Environmental Division facilities meets or exceeds local fire safety regulations.

All shipments of supplies and samples are carried out in accordance with the appropriate local, regional, federal, or international ordinances, including the Transportation of Dangerous Goods (TDG) Regulation. Staff responsible for the shipment of Dangerous Goods have received TDG training.

WASTE MANAGEMENT

Waste management procedures are developed by each ALS location for all wastes designated as hazardous, and to ensure that all waste disposal practices meet local regulatory requirements. Refer to site-specific procedures.

FUME HOODS

Fume hoods are available in all laboratory sections where required to meet safety needs. Fume hood face velocities are regularly monitored. Refer to site-specific procedures and/or records.

5.4 TEST METHODS AND METHOD VALIDATION

Refer to NA-SP-0100 Initial Method Validation, NA-SP-0101 MU Principles and NA-SP-0102 Method Revalidation and MU for details. Local procedures apply to other disciplines where needed.

5.4.1 General

ALS locations use appropriate, documented methods for all tests performed. Templates for national and local test methods specify the minimum documentation requirements. Test method instructions and support information is kept current and accessible where the work is performed.

Deviations from test methods occur only if the deviation has been documented, technically justified, authorized, and accepted by the customer where applicable. Analytical department supervisors and managers have the authority to approve method deviations for the analysis of samples and to impose appropriate quality control into the analysis. If the deviation is judged to alter the outcome of a test, client acceptance of the deviation will be obtained prior to approval. These isolated occurrences can be documented using the record keeping system established for single event test method nonconformances. Refer to section 4.9.

5.4.2 Selection of Methods

Customers rely on ALS to select test methods that are scientifically valid, defensible, and appropriate to meet their needs. Where possible, ALS uses the latest versions of published standard methods developed by organizations such as the American Public Health Association, the United States Environmental Protection Agency, the National Institute for Occupational Safety and Health, Environment Canada, and other international, regional, or regulatory organizations, or equipment manufacturers. When needed, standard methods are supplemented with additional instructions to ensure consistency of application and performance and to comply with the content requirements of ALS document templates. Where an appropriate standard method is not available, ALS may develop and validate an in-house test method, or may adopt a third-party validated method. ALS provides method information to clients on test reports and upon request.

For published reference methods, each ALS location confirms it can properly operate the standard method before introducing the test into the laboratory. If a future revision of the standard method causes it to change in a manner that may affect test results, the confirmation is repeated.

Unique circumstances may occur where a customer specifies the methodology to be used. The customer will be notified if ALS deems the recommended method to be inappropriate or out of date.

5.4.3 Laboratory Developed Methods

When in-house development of a test procedure is needed, qualified individuals are assigned to the planning and development stages of the project. The plan is updated as development progresses and all changes are effectively communicated to everyone involved to ensure that objectives are met.

5.4.4 Non-standard Methods

If it is necessary to use methods not covered by standard methods, customer agreement will be obtained. The test methods will include or reference clear specification of the requirements and the purpose of the test. The developed method will be appropriately validated before use.

5.4.5 Validation of Methods

Method validations are conducted to confirm that the developed methods are fit for their intended use. The validations are as extensive as necessary to meet the needs of the given application. The extent depends on the source of the method. For example, standard methods used for their intended application require a less extensive validation than non-standard methods or standard methods used outside of their intended scope.

All results relating to the validation of a given method, including the procedure used for validation and a statement of whether the method is fit for its intended use are retained in method validation records.

As appropriate, validation studies performed will verify the range and accuracy of the test method, including measurement uncertainty, detection limit, selectivity (i.e. sensitivity to interference), linearity, repeatability and/or reproducibility, and robustness. Measurement uncertainty values are reviewed to ensure they are sufficient to meet customers’ needs.

Chemistry test methods are revalidated periodically to ensure continued suitability and fitness for purpose. Revalidation is routinely scheduled as part of the internal audit process. Revalidation frequency is based on test method performance and the requirements of applicable accrediting bodies. Refer to section 4.14 for additional information regarding internal audit schedules. Revalidation may also occur at any time when the performance of a test method is under investigation. At minimum, revalidation includes an examination of precision and bias data, an evaluation of detection limits and limits of reporting and an estimation of measurement uncertainty.

5.4.6 Estimation of Measurement Uncertainty

The ALS procedure for estimating measurement uncertainty is based on accepted practices of identifying components contributing to uncertainty, compiling data that represents or includes these components, evaluating the data using appropriate statistical calculations, and reporting in a manner that prevents misunderstanding of the result.

In those cases where the nature of the test precludes calculation of uncertainty, ALS will at minimum identify the components of uncertainty and make a reasonable estimation where needed. This estimation will be based on available validation data and other sources of information about the test method’s performance.

5.4.7 Control of Data

Refer to NA-SP-0850 Electronic Data Control and Security and NA-SP-0150 Creation and Validation of LIMS Products for details.

Automated calculations and data transfer systems are checked in a systematic manner when first programmed and are re-verified appropriately when changes are made.

When computers and automated equipment are used for the acquisition, processing, recording, reporting, storage, or retrieval of test data, ALS ensures:

- In-house developed software is sufficiently documented and validated.
- Procedures are implemented for protecting data, including integrity and confidentiality of entry, collection, storage, transmission, and processing – refer to sections 4.13, 5.1 and 5.10.
- Computers and automated equipment are maintained to ensure proper functioning and adequate environmental conditions – refer to section 5.1.

5.5 EQUIPMENT

Refer to NA-SP-0051 Equipment Maintenance Contracts and NA-SP-0078 Equipment Inventory for details.

5.5.1 ALS laboratories use appropriate sampling and testing equipment and instrumentation to ensure test method performance meets client needs. If ALS locations use equipment that is outside of their permanent control, the laboratories are responsible for ensuring the equipment meets the requirements of this section.

5.5.2 All equipment and its software needed for testing meets required performance specifications. Equipment is calibrated at the frequency stated in specific test methods and is confirmed to achieve required accuracy. Calibration and verification programs are established where appropriate.

5.5.3 Authorized staff use documented test methods and procedures to operate, calibrate and maintain equipment. Relevant operating manuals or other work instructions are available where needed.

All proposals for maintenance contracts are reviewed and authorized nationally by the TD.

5.5.4 Equipment and its software are uniquely identified where practical. Inventory lists are maintained of all equipment with a new or replacement value of greater than $750.00 CAD, excluding consumables, vehicles, and furniture.

5.5.5 Instrument logbooks and/or maintenance records contain the following information relating to instrumentation and software:

- Equipment and software identification.
- Manufacturer’s name, model and serial number.
- Performance check records.
- Current location where appropriate.
- Manufacturer instructions (alternatively referenced in test method).
- Calibration history, adjustments, acceptance criteria (alternatively referenced in test method), and due date of next calibration (except for equipment calibrated on an as-used basis).

- Maintenance schedules (alternatively referenced in test methods), and records of maintenance.
- Records of damage, malfunction, repair, or modification.

5.5.6 Documented instructions describe the management of measuring equipment and instrumentation, including:

- Safe handling, transport where applicable, storage and use.
- Planned maintenance.
- Intermediate calibration checks.
- The application of correction factors and updating of software or other records, where applicable.

5.5.7 Any equipment known or suspected to be defective is removed from service, isolated where practical, and clearly labeled as being out of service. The equipment is not returned into use until it is examined, necessary repairs have been completed, and it has been verified to meet performance specifications. Records are maintained in equipment logbooks. Where the defect calls reported analytical results into question, corrective action will be implemented – refer to sections 4.9 and 4.11.

5.5.8 Where practical, equipment under the control of the laboratory will be labeled to identify its calibration status. The label will include the date last calibrated and the expiration criteria or other indication of when re-calibration is due. Labels are not practical when the equipment is calibrated on a daily basis or when labels will interfere with the operation of the equipment. In such cases, other tracking mechanisms are implemented.

5.5.9 When it is necessary for equipment to go outside of the direct control of a laboratory, it will not be returned to service until it is demonstrated to meet performance specifications. Records are maintained in equipment logbooks or maintenance records.

5.5.10 When intermediary checks are needed to maintain confidence in the calibration status, the checks are carried out according to documented procedures. Refer to section 5.5.6.

5.5.11 Where calibrations result in correction factors, procedures for applying the corrections are documented. Refer to section 5.5.6.

5.5.12 Equipment is situated in the lab in a manner that will protect it from inadvertent adjustments. Specific equipment settings are documented where these settings can affect analytical results. Correct equipment adjustment is included in the training provided to individuals working with equipment.

5.6 MEASUREMENT TRACEABILITY

Refer to local procedures for details.

5.6.1 Wherever possible, ALS measurement and testing equipment that can have a significant effect on the accuracy or validity of test results is calibrated using established procedures. Calibration procedures ensure traceability through an unbroken chain of calibrations or by comparison to national measurement standards.

When using external calibration services, traceability of measurement is assured where applicable by the use of laboratories that can demonstrate competence, measurement capability, and traceability through accreditation to ISO/IEC 17025:2005 or ISO/IEC 17025:2017 during the transition phase. The calibration certificates issued by these laboratories relate their accreditation status and contain the measurement results, measurement uncertainty, and a statement of compliance with an identified metrological specification.

5.6.2 Where traceability of measurements to SI units is not possible and/or not relevant, traceability is provided by the use certified reference materials and/or consensus standards.

5.6.3 Reference Standards and Reference Materials

5.6.3.1 Reference Standards

Reference standards such as reference thermometers are calibrated by service providers that have demonstrated competence by being accredited to ISO/IEC 17025:2005 or ISO/IEC 17025:2017 for the required calibrations. This equipment is used for no purpose other than demonstrating that equipment is within calibration specifications, unless it can be demonstrated that their performance is not invalidated by the other uses. Where adjustments are needed, re-calibration is performed.

5.6.3.2 Reference Materials

Reference materials purchased by ALS are traceable to SI units where possible or to other certified reference materials. Where available, they are purchased from ISO/IEC 17025:2005 or ISO/IEC 17025:2017 accredited suppliers. Internally prepared reference materials are checked as far as technically and economically feasible. Refer to individual test methods for information on the use of reference materials.

5.6.3.3 Intermediate Checks

Where checks are needed to maintain confidence in the calibration status of reference standards, primary standards, working standards, or reference materials, such checks will be carried out according to defined procedures and schedules.

5.6.3.4 Transportation and Storage

Reference standards and materials are handled, stored, and transported in a manner that protects their integrity and operation. Local procedures relate criteria for the transportation and storage of reference standards where needed. Refer to individual test methods for handling and storage of reference materials. ALS laboratories do not normally transport reference materials. If needed by specific locations, transportation procedures will be available on-site.

5.7 SAMPLING

5.7.1 ALS Canada locations do not collect field samples, except in rare situations where requested by the client. In these cases the client is asked to provide detailed sampling instructions.

Subsampling from submitted sample containers is conducted in a manner to obtain representative sub-samples. The error associated with subsampling is statistically monitored by collecting duplicate sub-samples for test procedures where subsampling occurs. Sub-sampling instructions are included or referenced in test methods where applicable.

5.7.2 Where a client requires deviations, additions, or exclusions from our documented sampling procedures, they are recorded in detail with the appropriate sampling data, are communicated to all appropriate personnel, and are indicated in final test reports.

5.7.3 Where applicable, ALS laboratories record relevant data and operations related to sub-sampling. The records include for example, identification of the sampler, date of sampling, applicable weights or volumes, deviations, and other information where relevant.

5.8 HANDLING OF SAMPLES

Refer to NA-SP-0325 Protocols for Sample Handling on Receipt for details.

ALS sample handling procedures include transportation conditions, receipt, handling, protection, storage, retention, and disposal. Sampling and Handling Guides are provided to customers where needed. The procedures are designed to protect the integrity of the test samples and the interests of the customer and ALS.

ALS requests that our customers use our Chain of Custody (COC) form for every shipment of samples. The form includes sufficient space to record field sampling date, time and location of sampling, sample ID, and information relating to the integrity of the sample as collected. COCs are shipped with field supplies, and are also available on the alsglobal.com web site.

Samples are given a unique identification upon receipt. The identification is retained by the sample throughout its life in the laboratory, and ensures samples are not confused either physically or in records or reports. Where appropriate, the system allows for subdivision of test items and transfer within and between laboratories.

Abnormalities or other departures from specified sampling or transportation procedures are documented. Where there is doubt concerning the integrity of the sample, its identification or suitability for testing, or the requested tests, the customer is consulted for further instructions before proceeding, and the discussion is documented.

All ALS locations have appropriate facilities to securely maintain sample integrity, both before testing and where archiving for future testing is required. Sample storage and handling criteria are identified in test methods. Where important to protecting sample integrity, storage conditions are monitored and recorded.

5.9 ASSURING THE QUALITY OF TEST RESULTS

Refer to NA-SP-0104 Quality Control Protocols, NA-SP-0109 Creating, Maintaining and Monitoring Control Charts, NA-SP-0175 Data Validation of Test Data and supplemental procedures describing the proficiency testing program for details.

The ALS quality control (QC) protocols monitor the validity of tests performed by its laboratories. Individual test methods specify quality control requirements, including frequency of use and data quality objectives (DQOs) that trigger corrective action when exceeded. DQOs are based on a combination of reference method objectives, customer requirements, and historical test method performance. Where applicable, regulatory requirements or prescriptive elements of reference methods take precedence over internal DQOs.

QC elements utilized include but are not limited to functional checks of measuring and testing equipment, calibration standards, reference samples, control samples, verification standards, blanks, sample duplicates, surrogate compounds, and matrix spikes as appropriate to the field of testing.

Where appropriate, QC results are recorded on control charts. Control limits and statistical techniques are used to monitor test method performance for important trends. Planned action is taken to correct problems and to prevent incorrect results from being reported.

ALS laboratories participate in an extensive range of proficiency testing (PT) programs. PT samples are treated and analyzed on-site in a manner as similar to customer samples as possible, to ensure the test results represent customer test results. PT samples often require handling steps that are unique to the PT samples that differ from the steps in authorized test procedures. In these cases the unique steps are communicated to the applicable analytical departments by QA staff through Mobilization Meetings in order to minimize preventable errors. When various locations analyze the same PT samples, test results are not discussed or compared in any manner prior to the publication of the PT evaluation. Each accrediting body has specific policies regarding the analysis and reporting of proficiency testing samples. Local procedures describe the approaches used to meet the requirements.

Where possible, ALS will store samples for the following durations to accommodate retesting, measured from date of sample submission: 45 days for Soil and Water samples; 6 months for Tissue/Biota samples; 14 days for air samples collected on re-usable media; and 3 days for water samples submitted for microbiological testing. Where retesting identifies a nonconformance to policies and/or procedures, a nonconformance and corrective action is initiated – refer to section 4.9 and 4.11).

All ALS test results proceed through several validation steps by qualified individuals prior to the release of final test reports. The data validation process includes test result validation, inter-parameter validation, and report validation. Where data validation steps are prescribed by accrediting bodies, local procedures will provide details on responsibilities and processes.

The reporting of PT sample results to PT agencies requires unique manual data conversion and manual data entry steps after the report validation step is complete. A self-transcription check of the additional reporting steps is required at minimum, and a peer review is performed as needed. A record is maintained in either case.

5.10 REPORTING RESULTS

All information listed below is either included in the final report or kept on file at ALS in the case of abbreviated or customized reports, and can be provided to clients upon request:

- Title of report.
- Name and address of the laboratory issuing the report.
- Location where each test was conducted.
- Unique identification of the test report on each page, and the total number of pages.
- Customer name and address.
- Identification of test method(s) used.
- Unique identification of each sample, description of the sample such as matrix and customer identification, and condition where applicable.
- Date of sample receipt.
- Date of analysis.

- Test results and units.
- Report qualifiers.
- Name, function, and signature of the person authorizing the report.
- Statement that the results relate only to the samples identified in the report.

Other information necessary for the interpretation of results or requested by the customer may also be included in reports, such as test method deviations or exclusions, specific test conditions, measurement uncertainty estimates, date of sampling, location of sampling, and other sampling information.

Statements of compliance, opinions, and interpretations may be included on test reports for specific analyses. In all such cases, the basis on which they have been made will be documented and clearly identified in the test report.

ALS obtains subcontract laboratory results in hard or electronic reports. When these results are presented to the customer in ALS reports, the identification of the subcontractor is clearly indicated on the final report.

When test reports are transmitted by telephone, facsimile, e-mail or other electronic means, the procedure for protecting the integrity and confidentiality of data includes:

- Only providing results to those individuals specified by the client for each sample submission.
- Use of a standardized facsimile cover page or email footer that relates the procedures to follow if received in error.

It is ALS practice to never disclose information about a client's test results to a third party without the prior consent of the client, or unless compelled to by law. If ALS is obligated by law to disclose such information, the client will be informed prior to doing so.

Test report formats are designed to accommodate each type of test and customer specifications. In all cases, ALS ensures that final results are reported in a manner that minimizes the possibility of misunderstanding or misuse.

Test report amendments are made by issuing a replacement report, identifying that a revision was made, and describing all changes in the cover page comment section.

6.0 REFERENCES

Documents are available on the ALS network at: N:\Life Sciences\Environmental\Technical\Regulations & Standards\STANDARDS FOR ACCREDITATION, unless otherwise noted.

6.1 PRIMARY REFERENCES

ISO/IEC 17025:2005 General Requirements for the competence of testing and calibration laboratories, Second Edition, 2005-05-15.

ISO/IEC 17025:2017 General Requirements for the competence of testing and calibration laboratories, Third Edition, 2017:11.

Quebec Accreditation Program for Analytical Laboratories (PALA) Requirements and Standards, DR-12-PALA, March 6, 2012, and supporting policies and program documents.

The NELAC Institute (TNI) Standard ELV1-2016-Rev2.1.

The USA Department of Defense (DOD) Quality Systems Manual Version 5.1.1 2018.

6.2 SECONDARY REFERENCES

The Canadian Association for Laboratory Accreditation (CALA) program requirements at: cala.ca.

Perry Johnson Laboratory Accreditation (PJLA) program requirements at: pjla.com.

7.0 VERSION HISTORY

Doc ID	Version No.	Version Date	Author(s)	Summary of Changes
NAQM1	01	18-Feb-2007	L. Neimor / P. Mueller	Defining the harmonized ALS management system.
NAQM1	02	07-Sep-2007	L. Neimor	Refer to v02 for details.
NA-QM-1	03	01-Jun-2009	L. Neimor	Refer to v03 for details.
NA-QM-0001	04	22-Nov-2011	L. Neimor	Refer to v04 for details.
NA-QM-0002	01	01-Mar-2018	L. Neimor	Refer to NA-QM-0002 v01 for details.
NA-QM-0002	02	02-Oct-2018	L. Neimor	Minor clarifications, and the following updates: - 2.0: added Quebec PALA (re BU PALA assessment). - 4.1.2: added compliance with requirements of PALA (re BU PALA assessment). - 4.1.5 intro to table and table content: added text re alternates; standardized reference to QA; minor clarifications in table; changed Technical Services Manager to Technical Director. - 4.2.8: added this cause for PALA accreditation and authorized signatory qualifications (re BU PALA assessment), and for SK MOE work. - 4.5 & 4.5.3: updated for NA-SP-0052. - 5.7.1: added field sampling is rare and clients are asked to provide detailed sampling instructions. (re GP technical audit). - 5.8: updated NA-SP-0325 title. - 6.1: corrected ISO/IEC 17025:2017 reference to 3rd edition; added PALA program requirements.

8.0 TNI / DOD ADDITIONAL LABORATORY INFORMATION

Only locations that hold TNI or DOD accreditations are to complete this section. Note that this manual applies to all organizational units as described within the document.

LABORATORY ADDRESS AND PHONE NUMBER	
Street Address:	
City, Province, Postal Code:	
Phone Number:	

RESPONSIBLE PARTIES			
Title	**Name**	**Signature**	**Date**
General Manager:			
Technical Manager:			
Quality Coordinator:			

Appendix C

Chain-of-Custody Form and Sample Matrix

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ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # ____________________

Page ____ of ____

Report To
Company: Constantine North Inc.
Contact: Allegra Cairns
Address: West Pender St. Suite 320-800
Vancouver, BC, V6C 2V6
Phone: 604-629-2348 Fax:

Invoice To Same as Report ? ☐ Yes ☑ No
Hardcopy of Invoice with Report? ☐ Yes ☑ No
Company: Constantine North Inc.
Contact: Allegra Cairns
Address: West Pender St. Suite 320-800
Vancouver, BC, V6C 2V6
Phone: 604-629-2348 Fax:

Lab Work Order # (lab use only)

Report Format / Distribution
☐ Standard ☑ Other
☑ PDF ☑ Excel ☐ Digital ☐ Fax
Email 1: allegra@constantinemetals.com
Email 2:
Email 3:

Client / Project Information
Job #:
PO / AFE:
LSD:
Quote #:

ALS Contact: Carla Fuginski **Sampler:** Allegra Cairns

Service Requested (Rush for routine analysis subject to availability)
● Regular (Standard Turnaround Times - Business Days)
○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	**Sample Identification** (This description will appear on the report)	**Date** (dd-mmm-yy)	**Time** (hh:mm)	**Sample Type**	Acidity/Alkalinity	TDS/TSS	Turbidity	Total Phosphorus	Cl, F, SO4	Dissolved Phosphorus	Br	Ammonia as N	Nitrate/nitrite (complex) as N	Total Metals	Hardness as $CaCO_3$	Dissolved Metals	Total Mercury	Dissolved Mercury	WAD Cyanide	Bottle Size (mL)	Bottle Type	Preservative	Number of Containers
										F/P		P	P	P	P	F/P	P	P	P				
	Location ID			Surface Water	X	X	X	X	X											500	HD	N/A	1
				Surface Water						X										125	AG	S	1
				Surface Water							X									125	HD	N/A	1
				Surface Water								X								125	AG	S	1
				Surface Water									X							125	AG	S	1
				Surface Water										X	X					125	HD	N	1
				Surface Water												X				125	HD	N	1
				Surface Water													X			40	AG	H	1
				Surface Water														X		40	AG	H	1
				Surface Water															X	125	HD	SH	1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Analyze per QAPP specifications - Table A7-1. Bottle Types: HD = HDPE, AG = Amber glass Preservatives: N/A = None, N = HNO_3, S = H_2SO_4, SH = NaOH, H= HCl

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature: °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

GENF 18.01 Front

Palmer Project Sample Collection Matrix Table

		Field Parameters[a]						Lab Analyses[b, c]																
	Analysis	**Dissolved Oxygen**	**pH**	**Temperature**	**Turbidity**	**Conductivity**	**Settleable Solids**	**Ammonia as N**	**Nitrate + Nitrite (Complex)**	**Br**	**TDS**	**TSS**	**Acidity**	**Alkalinity**	**Cl, F, SO_4**	**Total P**	**Turbidity**	**Dissolved P**	**WAD Cyanide**	**Total metals**	**Hardness as $CaCO_3$**	**Dissolved Metals**	**Total Hg**	**Dissolved Hg**
	Analytical Methods						SM 2540F	J. Environ. Monit., 2005	EPA 352.3	EPA 300.1	SM 1030E	SM 2540D	SM 2310B	SM 2320	EPA 300.1	SM 4500-P	SM 2130	SM 4500-P	SM 4500-CN	EPA 6010B/6020A	Calculation	EPA 6010B/6020A	EPA 1631E	EPA 1631E
	Sample Container						2 x 1 L HDPE	125 mL AG	125 mL AG	125 ml HDPE	500 mL HDPE							125 ml HPDE	125 mL HDPE	125 mL HDPE VCB		125 mL HDPE VCB	40 mL Glass	40 mL Glass
	Minimum Sample Volume						1 L	50 mL	50 mL	100 ml	250		50 mL		100 mL			100 nL	30 ml	50 mL		50 mL	30 mL	30 mL
	Field Filtration (Yes/No)						No	No	No	No	No							Yes	No	No	No	Yes	No	Yes
	Lab Filtration (Yes/No)						No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No
	Preservation						None	pH <2; 1:1 H_2SO_4	pH <2; 1:1 H_2SO_4	None	None							pH <2; 1:1 H2SO4	pH >12; NaOH	pH <2; 1:3 HNO_3		pH <2; 1:3 HNO3	pH <2; 1:1 HCl	
	Maximum Holding Time						48 h	28 d		28 d	7 d		14 d		28 d	28 d	48 hours	28 d	14 d	90 d		90 d	28 d	28 d
	Holding Temperature						4 ± 2 °C do not freeze	4 ± 2 °C do not freeze		4 ± 2 °C do not freeze	4 ± 2 °C do not freeze							4 ± 2 °C do not freeze	4 ± 2 °C do not freeze	NA		NA	NA	NA
Sample ID	**Location Description**																							
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
		X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
P20	Field Replicate	X	X	X	X	X	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______
P21	Field Blank							Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______		Tag #_______		Tag #_______	Tag #_______	Tag #_______	Tag #_______	Tag #_______

Notes:

AG = amber glass
APHA = American Public Health Association
d = day
EPA = U.S. Environmental Protection Agency
HDPE = high density polyethylene
HCl = hydrochloric acid
HNO_3 = nitric acid
H_2SO_4 = sulfuric acid
NA = not applicable
NaOH = sodium hydroxide
SM = Standard Methods
X = indicates sample to be collected

[a] Field parameters to be collected *in-situ* . Field measurement probe model information and calibration information to be recorded for each sampling station.

[b] Dissolved metals samples to be collected using peristaltic pump and filter. Filter size and type to be recorded.

[c] All other samples to be collected as grab samples, using amber glass or other nonreactive container filled from stream and poured into sample bottles. In cases where low stream flow, safety hazards, or other issues prevent use of the grab sample technique, the peristaltic pump will be used to fill all sample bottles.

Appendix D

Field Sampling Standard Operating Procedures

PALMER PROJECT SURFACE WATER , GROUNDWATER, AND WASTEWATER SAMPLING—
STANDARD OPERATING PROCEDURES

Field Observations

Visual observations of current environmental conditions provide a qualitative measure of sample representativeness and can be useful when compared to other sampling events and/or locations. Field staff should record their observations of the physical setting at each sampling location and for each sampling event. In particular, field staff should note current and recent prior weather conditions, physical characteristics (approximate flow rate, color, and smell), and changes from prior sampling events. For surface water, channel morphology in the project area is highly active. During each sampling event, the sampling locations will be visually investigated to determine if they are still representative of the surface water bodies characterized by previous data sets. Stream channel morphology, water physical characteristics, and weather observations will be recorded on field data sheets. Photographs of sampling locations and stream conditions immediately upstream and downstream may also be taken to document conditions at the time of sampling.

For groundwater sampling, the condition of the monitoring well will be documented including noticeable settling, movement, or damage. As in surface water sampling, water physical characteristics and weather observations will be recorded on the field data sheets. Photographs of the monitoring wells will be taken to document the conditions of the wells at the time of sampling.

For wastewater sampling, the condition of the pipe around the valve and the valve itself will be documented. Water physical characteristics and any conditions that could have impacts on the quality of the data will be documented on the field sheets.

In Situ Measurements

In situ parameters will be monitored at every water quality sampling station during each sampling event. A multi-parameter probe (“multiprobe”) or several individual probes will be used to measure the following key parameters: dissolved oxygen, redox potential, conductivity, temperature, pH, and turbidity.

Water Quality Parameter Measurements Using Multiprobe

The purpose of this standard operating procedure (SOP) is to describe the procedures for calibration and measurement of general water quality parameters using multiprobe measurement instrument, such as a YSI 556 Multiprobe (or equivalent instrument). The procedures described here also generally apply to the use of individual probes. The field instruments used must meet method requirements specified in the project quality assurance project plan (QAPP).

For surface water samples, if the conditions are safe and if water at the sampling location is deep enough to adequately submerge the probe, the probe will be placed directly in the stream. (If conditions are unsafe or if water is too shallow, a peristaltic pump may be used to supply a continuous flow of water to a clean, non-reactive container, and the probe placed in the container.) Measurements will be recorded when the field instrumentation readings have stabilized. The *in situ* parameters and other observations will be recorded into a field logbook and field data sheets. Later, the data will be transferred to a database and field data sheets will be photocopied or electronically scanned to ensure that the data records are preserved.

Specific instructions for collecting *in situ* water quality measurements are outlined in instrument manuals. Field staff will follow these basic steps for each measurement:

1. Turn the instrument on and check for error messages. If error alerts are present, address all errors prior to recording measurements.
2. Make sure the probe sensor guard is installed, if applicable.
3. Place the probe module in the sample. Be sure to completely immerse all the sensors.
4. For a multiprobe or dissolved oxygen probe, rapidly move the probe module through the sample to provide fresh sample to the dissolved oxygen sensor.
5. Watch the readings on the display until they are stable.
6. Record data on Sample Collection Form.

Calibration

The measurement probe unit(s) will be regularly calibrated and maintained to ensure the accuracy of the data collected. Calibration and maintenance logs will be kept, with each calibration event recorded. For each sampling event and station, the specific probe model number and source information will be documented in the field logbook and field data sheets.

If instruments are rented from a third-party supplier, they may be pre-calibrated before use in the field. In that case, daily calibration checks will be performed for all water quality parameters, except temperature, according to this SOP and in conjunction with the operating manual supplied by the manufacturer. Daily calibration log forms are included in Appendix E.

Daily Calibration Procedures

The following sections describe how the multiprobe is calibrated daily prior to sampling. These specific steps apply to the YSI 556 instrument; however, the procedures generally apply to calibration checks for other brands of multiprobes and to individual probes. Note that some steps and terminology used here will vary for different instrument makes and models. The specific instructions in instrument manuals should be followed for each instrument used in the field.

Dissolved Oxygen (in mg/L)

Dissolved oxygen calibration in mg/L is carried out in a water sample that has a known concentration of dissolved oxygen. Detailed calibration steps are included in the instrument manual.

1. Go to the calibrate screen.
2. Use the arrow keys to highlight the **dissolved oxygen mg/L** selection.
3. Press **Enter**. The dissolved oxygen mg/L entry screen is displayed.
4. Place the probe module in water with a known dissolved oxygen concentration. **Make sure to completely immerse all the sensors.**
5. Use the keypad to enter the known dissolved oxygen concentration of the water.
6. Press **Enter**. The dissolved oxygen mg/L calibration screen is displayed.
7. Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the dissolved oxygen sensor.
8. Allow at least 1 minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
9. Observe the dissolved oxygen mg/L reading. When the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to continue.
10. Press **Enter**. This returns you to the dissolved oxygen calibration screen.
11. Press **Escape** to return to the calibrate menu.
12. Rinse the probe module and sensors in tap or purified water and dry.

pH

Water pH calibration is carried out using standardized water samples with known pH values. Detailed calibration steps are included in the instrument manual. Two-point or 3-point calibration using pH standards that cover a broad range of pH values is recommended.

1. Go to the calibrate screen.
2. Use the arrow keys to highlight the **pH** selection.
3. Press **Enter**. The pH calibration screen is displayed.
4. Select the **1-point** option only if you are adjusting a previous calibration. If a 2 point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a 1-point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.
5. Use the arrow keys to highlight the **1-point** selection.
6. Press **Enter**. The pH entry screen is displayed.

7. Place the correct amount of pH 7 buffer into a clean, dry, or pre-rinsed transport/calibration cup.
    a. 30 mL (upright) or 60 mL (upside down).
    b. Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Avoid cross-contamination of buffers with other solutions.
8. Carefully immerse the sensor end of the probe module into the solution.
9. Gently rotate or move the probe module up and down to remove any bubbles from the pH sensor. **Make sure to completely immerse the sensor.**
10. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten. Do not overtighten because this can cause damage to the threaded portions.
11. Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**. Values for pH vs. temperature are printed on the labels of all pH buffers.
12. Press **Enter**. The pH calibration screen is displayed.
13. Allow at least 1 minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
14. Observe the reading under pH. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to continue.
15. Press **Enter**. This returns you to the specified pH calibration screen.
16. Press **Escape** to return to the calibrate menu.
17. Rinse the probe module, transport/calibration cup, and sensors in tap or purified water and dry.

Conductivity

Conductivity calibration is carried out using standardized water samples with known conductivity values. For some instruments, performing a conductivity calibration automatically also calibrates specific conductance and salinity. Detailed calibration steps are included in the instrument manual.

1. Go to the calibrate screen.
2. Use the arrow keys to highlight the **Conductivity** selection.
3. Press **Enter**. The conductivity calibration screen is displayed.

4. Use the arrow keys to highlight the specific conductance selection.
5. Press **Enter**. The conductivity calibration entry screen is displayed.
6. Place the correct amount of conductivity standard into a clean, dry, or pre-rinsed transport/calibration cup.
    a. 55 mL (upright or upside down).
    b. For maximum accuracy, the conductivity standard should be within the same conductivity range as the samples you are preparing to measure.
        i. For fresh water, use a 1 mS/cm conductivity standard.
        ii. For brackish water, use a 10 mS/cm conductivity standard.
        iii. For seawater, use a 50 mS/cm conductivity standard.
    c. Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that can be discarded. Avoid cross-contamination of solutions. Make sure that there are no salt deposits around the oxygen and pH sensors, particularly if you are employing standards of low conductivity.
7. Carefully immerse the sensor end of the probe module into the solution.
8. Gently rotate or move the probe module up and down to remove any bubbles from the conductivity cell. **The sensor must be completely immersed past its vent hole.**
9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten. Do not overtighten because this can cause damage to the threaded portions.
10. Use the keypad to enter the calibration value of the standard you are using. Be sure to enter the value in **mS/cm at 25°C**.
11. Press **Enter**. The conductivity calibration screen is displayed.
12. Allow at least 1 minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
13. Observe the reading under specific conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and will prompt you to press **Enter** again to continue.
14. Press **Enter**. This returns you to the conductivity calibrate selection screen.
15. Press **Escape** to return to the calibrate menu.
16. Rinse the probe module and sensors in tap or purified water and dry.

Turbidity Measurements

The purpose of this SOP is to describe the procedures for the measurements of turbidity while in the field.

A field turbidity instrument that meets method requirements specified in the QAPP, such as a LaMotte 2020e or equivalent instrument, will be used. Sample water will be collected with the tube directly in the stream flow or with a non-preserved sample bottle and then poured into the tube. The turbidity value and any associated dilution records will be recorded into a field logbook and field data sheets. Later, the data will be transferred to a database and field data sheets will be photocopied or electronically scanned to ensure that the data records are preserved.

The following sections describe how the LaMotte 2020e instrument is used to measure turbidity *in situ*. These general steps also apply to other types of turbidity meters. Note that some steps and terminology used here will vary for different instrument makes and models. The specific instructions in instrument manuals should be followed for each instrument used in the field. Field staff will follow these basic steps for each turbidity measurement:

1. Press ***ON** to turn the meter on.
2. Press ***OK** to select **Measure**.
3. Rinse a clean tube three times with the blank. For the most accurate results, use the same tube for the blank and the sample.
4. Fill the tube to the fill line with the blank. Pour the blank down the inside of the tube to avoid creating bubbles.
5. Dry the tube with a lint-free cloth. Put on a dry positioning ring. Cap the tube. Wipe the tube thoroughly again with a lint-free cloth.
6. Open the meter lid. Insert the tube into the chamber. Align the index notch on the positioning ring with the index arrow on the meter. Close the lid.
7. Press ***OK** to select **Scan Blank**. Remove the tube.
8. Rinse a clean tube, or the same tube, three times with the water to be tested. Avoid spilling water on the outside of the tube. While the tube is inverted, wipe the lip of the tube to remove droplets of liquid that may be present. This will prevent liquid from being trapped under the ring when the tube is returned to an upright position.
9. Repeat Steps 4 through 7 with the water to be tested.
10. Record data on Sample Collection Form.

Because of natural site conditions, highly turbid samples may exceed the measurement capability of field meters. If turbidity measurements do not fall within the calibrated range of the field instrument, dilutions should be performed in the field to obtain accurate measurements. If a sample is encountered that is more than the upper limit of the field instrument, a careful dilution with 0 nephelometric turbidity units (NTU) or very low turbidity water will bring the sample into an acceptable range. If field staff are unsure of the accurate range of the meter, dilute all turbidity samples that measure greater than 40 NTU in the field, according to procedures outlined in U.S. Environmental Protection Agency Method 180.1 (USEPA 1993). Note that particulates often react in an unpredictable manner when diluted.

To perform dilutions, follow the field dilution method outlined in the instrument manual. If instrument-specific instructions are not available, the following general procedure may be followed. The sample should be diluted with one or more volumes of turbid-free water (such as deionized water) until the turbidity falls within the instrument range. The diluted sample will be agitated for 30 seconds prior to sampling, and sampling will occur within 60 seconds of agitation. The volume of water added is the dilution factor; this value should be recorded. The turbidity of the original sample is then computed by multiplying the diluted turbidity sample reading by the appropriate dilution factor. The following table gives quick reference guidelines for common dilution proportions:

Sample Amount (mL)	Deionized Water Added to Bring Final Volume to 10 mL (mL)	Multiplication Factor
10	0	1
5	5	2
2.5	7.5	4
1	9	10
0.5	9.5	20

Turbidity Calibration Procedures

The turbidity unit will be regularly calibrated and maintained to ensure the accuracy of the data collected. Calibration and maintenance logs will be kept, with each calibration event recorded. For each sampling event and station, the specific probe model number and source information will be documented in the field logbook and field data sheets.

If instruments are rented from a third-party supplier, they may be pre-calibrated before use in the field. In that case, daily calibration checks will be performed according to this SOP and in conjunction with the operating manual supplied by the manufacturer. Daily calibration log forms are included in Appendix E.

Daily Calibration Procedures

The following section describes how to conduct calibration on the LaMotte 2020e turbidity instrument. These general steps also apply to other types of turbidity meters. Note that some steps and terminology used here will vary for different instrument makes and models. The specific calibration instructions in instrument manuals should be followed for each instrument used in the field.

Selecting a Turbidity Calibration Curve

1. Press **ON** to turn the meter on.
2. Scroll down and then press ***|OK** to select **Options**.
3. Scroll down and then press ***|OK** to select **Turbidity**.
4. Scroll down and then press ***|OK** to select **Calibration**.
5. Scroll down and then press ***|OK** to select a **Calibration** curve. Select **Formazin**.
6. Press ◄ to exit to a previous menu or make another menu selection or press **OFF** to turn the meter off.

Calibration

1. Press ***|ON** to turn the meter on.
2. Press ***|OK** to select **Measure**.
3. Rinse a clean tube three times with the blank (0 NTU standard).
4. Fill the tube to the fill line with the blank (0 NTU standard). Pour the blank down the inside of the tube to avoid creating bubbles.
5. Dry the tube with a lint-free cloth. Put on a dry positioning ring. Cap the tube. Wipe the tube thoroughly again with a lint-free cloth.
6. Open the meter lid. Insert the tube into the chamber. Align the index notch on the positioning ring with the index arrow on the meter. Close the lid.
7. Press ***|OK** to select **Scan Blank**. Remove the tube.
8. Repeat Steps 3 through 6 for the 1 NTU standard and the 10 NTU standard.
9. Press ***|OK** to select **Scan Sample**.
10. Record the result.
11. Press **OFF** to turn the meter off or press ◄ to exit to a previous menu or make another menu selection.

Note: The meter will remember the last scanned blank reading. It is not necessary to scan a blank each time the test is performed. To use the previous blank reading, instead of scanning a new one, scroll to **Scan Sample** and proceed. For the most accurate results, the meter should be blanked before each test and the same tube with tube positioning ring should be used for the blank and the reacted sample.

Surface Water Sampling, Field Filtration, and Preservation Techniques

Surface water samples will be collected by experienced field staff using standard protocols. The water quality samples will be submitted for analysis for the parameters that are specified in the project QAPP.

The surface water samples to be collected for the Palmer Project are grab samples (not composite) from streams and creeks. Each sample bottle will be filled individually directly from the stream. Samples will be collected in flowing water (away from eddies and interferences) as close to mid-channel as is safely possible, and will be collected at a depth of approximately 6 inches below the water surface. Samples will be collected only when and where the conditions are safe. During low flow conditions, the sampler may use a peristaltic pump to fill all sample bottles and avoid disturbance of stream bed sediment materials.[1]

If a peristaltic pump is used, the pump inlet will be placed in the flowing water portion of the stream and elevated as needed to avoid uptake of stream bed sediments. The sample container will be held near the pump outlet and then filled. The sample containers will be capped, labeled, and placed inside a cooler.

For filtered samples, the field sampler will use laboratory-supplied 0.45-µm filters or syringes. The sampler will draw 50 mL of DI water into the syringe, screw on the filter to the syringe, and flush the DI water on to the ground to field rinse the filter. Next, 20 mL of sample will be drawn into the syringe from a non-preserved collection bottle, screw the filter onto the syringe, and flush the filter for conditioning. Once the field rinsing and filter conditioning is complete, the sample can be filtered into a pre-preserved bottle. Begin filling the sample container by successively (if needed) filling the syringe and forcing sample through the filter directly into the sample bottle. If the syringe filters become clogged, replace the filter and flush with sample water prior to continuing to fill the sample bottle. Alternatively, filtered surface water samples may be collected using a peristaltic pump. For peristaltic-pump filtered samples, a 0.45-µm filter will be placed in-line at the tubing outlet. The filter will be field rinsed with 2 L of DI water followed with filter conditioning with 50 mL of sample water. Sample water from the filter will be collected in pre-preserved sample bottles, being careful to not overfill the bottles.

Laboratory-provided acid-washed or pre-preserved sample bottles should not be rinsed prior to filling.

The following steps briefly outline the sampling methods:

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[1] In low flow conditions, if a peristaltic pump is not available, the sampler may use a clean collection container to collect water from the stream and to fill the laboratory-provided sample bottles. The sampler will rinse an amber glass or other non-reactive collection container a minimum of two times in native stream water at the sample location. The collection container will then be used to fill individual sample bottles following the procedures described here.

In-Stream Grab Samples

- Ensure that the sampler is facing upstream and is well anchored to the shoreline (i.e., one arm holding onto bank object and other is sampling) if the bank is steep. Do not sample alone.
- The sampler must reach out, one full arm's length, towards the middle of the stream to achieve the optimal sample location. A mechanical arm or similar device may also be used to safely extend the sample container closer to mid-channel.
- Remove the container cap and submerge the sample container into the water column to a depth of approximately 6 inches. Tilt the bottle to fill to the desired level. Take care to not overflow the bottle, as this may release preservative from the bottle. Immediately remove the sample bottle from the flow of water and cap.

Peristaltic Pump Grab Samples

- For sample collection during low flow conditions (or for samples filtered using 0.45-μm in-line filters), each station will be sampled using a peristaltic pump equipped with clean high- or low-density polyethylene tubing. New or laboratory-cleaned tubing is used at each station (dedicated to that station only). The field environmental coordinator must ensure that sufficient replacement supplies are available at all times. A minimum of 250 mL of surface water will be flushed through the dedicated tubing using the peristaltic pump before collection of any samples.

Filling Sample Containers (In-Stream Grab and Peristaltic Samples)

- Remove lid of sample bottle and be careful to ensure that you do not come in contact with the inside of the cap or the bottle. *Do not pre-rinse the bottles—they should be clean as provided by the supplying laboratory and may contain a chemical preservative.*
- When filling the sample bottles, do not allow any sampling equipment (i.e., tubing or filter housing) to touch either the bottle or the water within it.
- For all inorganic samples (metals, conventionals, anions, nutrient, etc.), fill the sample bottle to the bottle collar, leaving a small amount of air space above the water.

General Protocols

The following text outlines the basic protocols that will be adhered to during the collection, filtration, and preservation of the surface water samples (in-stream grab and peristaltic samples):

- When sampling several locations within the same stream, samples should always be collected in order from downstream to upstream.
- If using a field probe *in situ*, place the probe into the stream, just downstream from the sample collection location (ensures that sediment disturbance does not impact the water quality samples).

- Samples must be clearly labeled, using an indelible marker, indicating the water quality sample site name, the date, the required analysis, the preservation (i.e., nitric acid [HNO_3] for metals samples) and any field filtration done.
- New, disposable, powder-free sample gloves will be worn during the collection, filtration, and preservation of each new set of samples. The gloves should not come into contact with the sample, the interior of the container, or the interior of the cap.
- General chemistry (physical parameters, dissolved anions, and nutrients) will be collected directly from the dedicated tubing into t each sample bottle being sure to not overfill if preservative is present. Do not pre-rinse the bottles.
- Total metals samples will be collected directly into a verified clean sample bottle (do not rinse) containing reagent-grade HNO_3. Pre-preserved sample bottles typically will be provided by the analytical laboratory. If pre-preserved sample bottles are not available or if preservative is lost, samples can be preserved in the field using one vial of reagent-grade HNO_3 preservative that is provided by the laboratory. After the sample bottle has been filled (and preservative has been added if needed), replace the cap and invert the sample bottle several times to ensure that the preservative is fully mixed. *The nitric acid should be handled with care (gloves and goggles), with further safety information outlined in the Workplace Hazardous Materials Information System (WHMIS) material safety data sheet.*
- Dissolved metals samples are filtered using a laboratory-provided 0.45-µm filter. Prior to collecting the sample, the filter should be flushed with site water, the flushing water should be discarded, then the dissolved sample should be collected directly from the flowing water passing though the filter into a verified clean sample bottle (do not rinse) containing reagent-grade HNO_3. Pre-preserved sample bottles typically will be provided by the analytical laboratory. If pre-preserved sample bottles are not available or if preservative is lost, samples can be preserved in the field using one vial of reagent-grade HNO_3 preservative that is provided by the laboratory. After the sample bottle has been filled (and preservative has been added if needed), replace the cap and invert the sample bottle several times to ensure that the preservative is fully mixed. *The nitric acid should be handled with care (gloves and goggles), with further safety information outlined in the WHMIS material safety data sheet.*
- Record the *in situ* parameters in field logbook and also record any other relevant field observations. The minimum information to be collected at each sampling day and at each site is summarized in the project QAPP.

Groundwater Well Sampling, Field Filtration, and Preservation Techniques

This SOP presents the methods to be used for monitoring well purging and groundwater sampling using low-flow (minimal drawdown) sampling methods. The procedures outlined in this SOP are in accordance with groundwater sampling methods recommended by USEPA (1992, 1996).

Equipment Required

- Electronic water level meter
- Multiprobe measurement instrument (such as a YSI 556 Multiprobe or equivalent instrument; individual probes may also be used) meter capable of measuring field parameters required by the QAPP
- Turbidimeter
- Flow-through cell
- Sampling equipment (one from list):
  - Submersible pump, such as a Grundfos Redi-flo2 or equivalent, including: pump, control box, power source (typically a portable generator or 12V battery)
  - Peristaltic pump: pump with pump head, silicone tubing, tubing connectors, power source (typically 12 V battery)
- Decontamination equipment and supplies (buckets, scrub brushes, deionized or distilled water, potable water, and Alconox® detergent)
- Groundwater sampling forms and logbook
- Laboratory supplied 0.45-micron capsule filters
- Sample tubing (type and length are project- and site-dependent)
- Sample tags/labels and appropriate documentation (e.g., chain-of-custody forms, logbook, and groundwater sample collection forms)
- Insulated cooler(s), chain-of-custody seals, Ziploc® bags
- Sample containers with preservative (if required), coolers, and ice or gel packs.

Procedures

The following sections provide guidelines for preparation for purging, well purging, and groundwater sampling.

Well Location

When arriving at the well location, before opening the well, the well should be inspected for damage, leaking, and/or settling. Inspect the well cap for any damage. Document any changes in field notebook and field data sheets.

Water Level Data Download

Before preparing the well for purging and sampling, download the water level datalogger according to manufacture instructions. Document the period of record and last recording for file downloaded and the battery status.Preparation for Purging

Preparation for purging includes inspecting the condition of the well, monitoring health and safety conditions, and calibrating and decontaminating sampling equipment. General procedures are presented below:

1. Ensure that the area around well head is clean and free of debris. If necessary, place a plastic drop cloth around well head to prevent sampling equipment from coming into contact with the ground surface.

2. Inspect condition of well (e.g., well in locked position, tightness of cap, measuring point well marked, disturbance of surface casing, straightness of well casing, condition of concrete pad). Indicate condition of well on the sampling form.

3. Remove well cap.

4. Decontaminate all equipment before use in each well. Wear nitrile gloves and/or other protective equipment during possible water-contact or equipment-contact activities. At a minimum, change gloves between each well or when it is possible for potential contaminants to be introduced into the well. Tubing should be replaced between wells. The submersible pump will be decontaminated between wells by scrubbing with an Alconox® solution, followed by rinses of tap water and deionized water, respectively.

5. Measure water level using a decontaminated electronic water level meter, following manufacturer instructions, when the water level in the well has equilibrated.

6. Calculate the well casing volume as follows:

   $$\text{well casing volume (gal)} = \pi(r^2)(h)(7.48\ \text{gal/ft}^3)$$

   Where:

   h = height of water in the well casing (i.e., depth to bottom of the well minus depth to water) in feet

   r = radius of the inside of the well casing in feet.

7. Calibrate the multiprobe as described in the Calibration section above or individual water quality meters for measuring field parameters, following the procedures for *in situ* measurements and instrument calibration. Install flow through cell, with multiprobe attached, at the end of the sample tubing, and collect temperature, pH, specific conductance, dissolved oxygen, redox potential, and turbidity measurements during purging in 3 to 5 minute increments and prior to sampling. Record equipment calibration and maintenance in the field logbook. Decontaminate meters between wells by rinsing with distilled or deionized water.

Well Purging

Monitoring wells are purged before groundwater samples are collected for analyses. The purpose of well purging is to remove stagnant groundwater from the well. Field parameters (e.g., pH, temperature, specific conductance, redox potential, dissolved oxygen, and turbidity) are measured during the purging process in 3 to 5 minute increments to verify that stagnant water has been removed and that groundwater conditions are stable prior to sampling to ensure a representative groundwater sample is collected. The groundwater is considered stabilized once three consecutive measurements meet the stabilization criteria list below. A variety of pumps, including submersible or peristaltic, can be used to purge and sample the monitoring well. Refer to the manufacturer's instructions for operation of the specified pump. General procedures for purging are as follows:

1. Remove well cap.

2. Connect pump.

   Submersible Pump (bladder or Grundfos):

   a. Remove the pump from the pump holder and rinse with distilled water.
   b. Connect appropriate length of tubing to pump.
   c. Connect the pump to control box.
   d. Connect the control box to the power supply.

   Peristaltic Pump:

   a. Connect new or pre-cleaned tubing to peristaltic pump.
   b. Connect the pump to the power supply.
   c. Lower the pump intake or intake tubing (as applicable) into the water column. The pump intake should be placed at the middle or slightly above the middle of the screened interval in confined aquifers (USEPA 1996) or in unconfined aquifers not screened across the water table. Place the pump intake near the top of the water column for unconfined aquifers screened across the water table (USEPA 1996).

3. Insert multiprobe into flow-through cell. Connect the discharge hose from the pump to the flow-through cell. Direct discharge from flow-through cell to an appropriately sized container to manage purge water.

4. Turn on the pump. Conduct purging at a rate that will minimize drawdown in the well (i.e., purge at a rate less than or equal to recharge, if possible). Recommended purge rates are generally less than 0.13 gal/min (0.5 L/min) (USEPA 1996), or a rate that results in minimal (i.e., less than 0.3 ft) of drawdown in the well. Actual purge rates will vary based on aquifer material and well construction.

5. Record field parameters on the groundwater sampling form or logbook every 3 to 5 minutes. Purging should continue at a constant rate until the water quality parameters have stabilized for three successive measurements according to the stabilization criteria

provided in the table below (USEPA 1996). In the event that even very low purge rates result in evacuation of the well, collect groundwater samples for laboratory analyses as soon as sufficient groundwater accumulates in the well, regardless of the stabilization of field parameters.

Field Parameter	Stabilization Criteria
Temperature	± 1°C
pH	± 0.1 standard units
Specific Conductance	± 3 percent
Dissolved Oxygen	± 10 percent OR 3 values <0.5 mg/L
Redox Potential	± 10 mV
Turbidity (nephelometric turbidity units)	± 10 percent or 3 values <5 NTU

Groundwater Sample Collection

Groundwater sampling is conducted following proper purging of the well. Where possible, groundwater samples for analyses should be collected directly from the pump discharge at the lowest rate possible to minimize cross contamination, suspension of solids, and aeration of the sample.

Sample groundwater after the water quality parameters have stabilized. The general procedures for groundwater sample collection are as follows:

1. Turn down flow rate on the control box so that water flow is stopped or minimal while maintaining sufficient pressure in the system to prevent water in the tubing or flow-through cell from flowing back into the well. If a peristaltic pump is used, turn off the pump. Take care not to release the pump head because the loss of suction will cause the water in the tubing to drain back into the well.

2. Disconnect the pump discharge hose from flow-through cell or cut the tubing just before the connection to the flow-through cell.

3. Introduce groundwater samples directly from the pump discharge tube into the proper sample container and fill it to capacity. Place a bucket beneath the sampling tube to catch any unsampled water. Target analytes, container types, and preservatives are specified in the QAPP.

4. Collect groundwater samples for multiple compounds in the recommended following order (USEPA 1992), if relevant:

    - Dissolved gases and total organic carbon (TOC)

  - Metals and cyanide
  - Major water quality cations and anions
  - Radionuclides.

5. Increase pump flow rate slightly so that the flow rate is approximately the same as was used for purging and fill necessary sample bottles.

6. Conduct field filtration. If applicable, attach a new, disposable filter cartridge (typically 0.45 µm) to the discharge line. Collect filtered samples last and pre-rinse them by running a minimum of 0.25 gal of groundwater through them prior to collecting the sample (USEPA 1996). Introduce filtered water directly into the appropriate sample container. Note that alternate field filtration methods, e.g., syringe filters, may be used as described in the QAPP.

7. Collect QA/QC samples (i.e., duplicate, replicate, as applicable) at the same time by filling all bottles from the same flow. The number and types of QA/QC samples are specified in the QAPP.

8. Label sample bottles with date, sample number, time, sampler's name, and type of preservative, as described in the project-specific QAPP. Place sample bottles in a cooler with ice or frozen gel packs to keep samples cool (4°C). Samples must be cooled continuously from the time of collection to the time of receipt at the laboratory.

9. Reconnect the discharge tubing to the flow-through cell with the multiprobe. Continue pumping for 1 to 2 minutes and collect a set of post-sampling field parameters. Record the parameters on the groundwater sampling form or in the logbook.

10. Remove pump and/or tubing from the well. Close and lock the well. Decontaminate the sampling equipment.

11. Complete chain-of-custody form, package samples for shipment, and ship samples or arrange for courier to laboratory.

12. Document all field observations made and data generated in conjunction with the sample collection on the groundwater field sampling form.

Wastewater Sampling, Field Filtration, and Preservation Techniques

Wastewater samples will be collected between the settling ponds and the lower diffuser from a valve in the pipe. As discussed previous in the Field Observations the condition of the pipe and valve should be documented on the field form and field notebook. Document any other potential anomalies or information that could cause an error or anomaly in the data.

Due to sampled being collected from a valve, a clean decontaminated bucket will be filled and the multiprobe will be placed in the bucket and allowed to stabilize. Once stabilized document the pH on the field forms.

The wastewater samples to be collected for the Palmer Project are grab samples (not composite) from the pipe valve. Each sampler will don clean nitrile or equivalent gloves before collecting samples. Each sample bottle will be filled individually directly from the valve without being overfilled.

Once sampled, label sample bottles with date, sample number, time, sampler's name, and type of preservative, as described in the project-specific QAPP and the WMP. Place sample bottles in a cooler with ice or frozen gel packs to keep samples cool (4°C). Samples must be cooled continuously from the time of collection to the time of receipt at the laboratory.

Complete chain-of custody form, package samples for shipment, and ship samples or arrange for courier to laboratory.

References

USEPA. 1992. RCRA ground-water monitoring: draft technical guidance. U.S. Environmental Protection Agency, Office of Solid Waste, Washington, DC.

USEPA. 1993. Method 180.1. Determination of Turbidity by Nephelometry. Revision 2.0. Environmental Monitoring Systems Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH. August 1993.

USEPA. 1996. Low-flow (minimal drawdown) ground-water sampling procedures. EPA/540/S-95/504. U.S. Environmental Protection Agency, Office of Research and Development, Office of Solid Waste and Emergency Response, Washington, DC.

Appendix E

Field Sampling Forms

Palmer Project

Sample Collection Form

Sample Collector Name(s): ______________________

Organization: ______________________

Station Location: ______________________

Sample ID: ______________________

Collection Date: ______________________

Location Coordinates: ______________________

Collection Time: ______________________

Datum: ______________________

Media: *surface water* *groundwater* *sediment* *soil* *other*___________

Sample Type: *normal* *replicate* *split* *other*__________

Sample Method: *grab* *composite* *in situ* *well* *other*__________

Field Parameters

Parameter	**Measurement Device**	**Units**	**Field Dilutions**		**Final Measured Value**
			Dilution Factor	**Diluted Value**	
Temperature		*C			
Barometric Pressure		mmHg			
Dissolved Oxygen		mg/L			
Dissolved Oxygen		%			
Specific Conductivity		uS/cm			
Conductivity		uS/cm			
pH					
Turbidity					

Analytical Samples

Target Analysis	**Sample Container Type**	**Sample Volume**	**Filtration Device**	**Preservative**
Anions	HDPE	125ML	none	none
cyanide	UV inhibited HDPE	60ML	none	Sodium Hydroxide
General	HDPE	500ML	none	none
t-metals	HDPE	60ML	none	nitric acid (red)
t-Hg	glass	40ML	none	HCl (yellow)
t-nutrients	brown glass	120ML	none	H2SO4 (purple)
d-metals	HDPE	60ML	.45 filter/syringe	nitric acid (red)
d-Hg	glass	40ML	.45 filter/syringe	HCl (yellow)
d-nutrients	brown glass	120ML	.45 filter/syringe	H2SO4 (purple)

Comments

Field Observations

Current weather

Recent weather patterns

Stream flow, color, smell, etc.

Sample location photos: Y / N Sample Location_________ Upstream________ Downstream________

Sampler signature ________________________________

Date ___________________

Palmer Project

Instrument Calibration Form

Date	Time	Instrument Make/Model	Calibration Solution Temperature (°C)	Parameter	Units	Calibration Standard				Calibration Values
						Standard Value	Certification Date	Expiration Date	Additional Information	Multiprobe/Meter Reading
				Dissolved Oxygen	mg/L					
				pH		pH 10 buffer pH 7 buffer pH 4 buffer				
				Conductivity	mS/cm					
				Turbidity	NTU	0 NTU				
						1 NTU				
						10 NTU				

Notes:

Field Staff Name ______________________________

Signature ________________________________

Settleable Solids Data Sheet

Volumetric Imhoff Cone Procedure, Standard Method 2540 F

Station Location: ______________________
Sample ID: ______________________
Collection Date/Time: ______________________

Analyst Name: ____________________
Analyst Organization: ____________________

Analysis Date	**Analysis Start Time**	**Analysis Stop Time**	**Duration**	**(A) Imhoff Cone Volume mL/L**	**(B) Volume of Liquid "Pockets" between Settled Particles (Visual Estimation) mL/L**	**(A – B) Final Solids Volume mL/L**	**Visible solids still suspended in water?**	**Visible Floating Materials (e.g., leaves, sheen)?**	**Color of Settled Solids**	**Photograph Taken?**
Settling 1: 60 minutes total (Settling for 45 minutes, followed by gentle stirring, then settling for an additional 15 minutes)										
Settling 2: 24 hours (optional)										
Settling 3: 48 hours (optional)										
Notes:										

GROUNDWATER SAMPLE COLLECTION FORM

Well Number ________________________
Sample No. ______________________
Date

Project Name: Palmer Project
Project Number:
Collector:

Well Information

Monument Condition ☐ Good ☐ Needs Repair____________________________________
Well Cap Condition ☐ Good ☐ Locked ☐ Replaced ☐ Needs Replacement
Elevation Mark ☐ Yes ☐ Added ☐ Other
Well Diameter ☐ 2-inch ☐ 4-inch ☐ 6-inch ☐ Other
Odor ☐ Comments

Purge Data

Total Well Depth ______ ft ☐ Clean Bottom 5 Muddy Bottom ☐ Not Measured
Depth to Water ______ ft
Casing Volume ______ ft (H20) X ________ gpf = ______ X 3 = __________ gallons

Purge Method

Pump Type ______________ Tubing ____________ ______________ Total volume purged __________
Sample Intake Depth ______________ Purge Rate __________
Purge Start Time Purge Stop Time Sample Rate

Field Parameters

Time	Water level	Gallons	pH	ORP (mV)	Temp (°C)	Conductivity (mS/cm)	Turbidity (NTU)	D.O.	Comments
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________
_____	______	______	_________	_________	__________	__________	_________	________	________________

Sampling Device

Filter Type: Size:

Sample Containers Collection Time____________

Tag No.	Type	Preservative	Analytical Method	QA Remarks

Samplers' Signature________________________________ Date _________________

Appendix F

Safety Data Sheets

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Effective date: 11/20/2014 **Revision:** 05/12/2015

ALCONOX

1 Identification of the Substance/mixture and of the Company/Undertaking

1.1 Product identifier

Trade name: **ALCONOX**

Application of the substance / the preparation: Cleaning material/ Detergent

1.2 Relevant identified uses of the substance or mixture and uses advised against:

No additional information available.

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer/Supplier:

Alconox, Inc.
30 Glenn St., Suite 309
White Plains, NY 10603
Phone: 914-948-4040

Further information obtainable from: Product Safety Department

1.4 Emergency telephone number:

ChemTel Inc.: (800)255-3924, +1 (813)248-0585

2 Hazards Identification

2.1 Classification of the substance or mixture Classification according to Regulation (EC) No 1272/2008:

Eye Irrit. 2B; H320: Causes eye irritation.

Information concerning particular hazards for human and environment:

The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:

The classification is according to the latest editions of the EU-lists, and extended by company and literature data

2.2 Label elements

Labelling according to Regulation (EC) No 1272/2008:

The product is classified and labelled according to the CLP regulation.

Hazard pictograms:

Signal word: Warning

Hazard-determining components of labelling:

Sodium Alkylbenzene Sulfonate

Hazard statements:

H320: Causes eye irritation.

Precautionary statements:

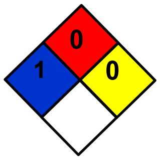
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P264: Wash thoroughly after handling.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses,if present and easy to do. Continue rinsing.
P337+P313: If eye irritation persists: Get medical advice/attention.

Other Hazard description:

WHMIS-classification and symbols:

D2B - Toxic material causing other toxic effects

NFPA ratings (scale 0 - 4)



Health = 1
Fire = 0
Reactivity = 0

HMIS-ratings (scale 0 - 4)

HEALTH	**1**	🟦
FIRE	**0**	🟥
REACTIVITY	**0**	🟨

Health = 1
Fire = 0
Reactivity = 0

2.3 Other hazards

Results of PBT and vPvB assessment

PBT: Not applicable.

vPvB: Not applicable.

3 Composition/Information on Ingredients

3.2 Chemical characterization: Mixture

Description: Hazardous ingredients of mixture listed below.

Identifying Nos.	**Description**	**Wt. %**
CAS: 68081-81-2	Sodium Alkylbenzene Sulfonate	10 - 25%
CAS: 497-19-8	Sodium Carbonate	5-15%
CAS: 7722-88-5	Tetrasodium pyrophosphate	5-15%
CAS: N/A	Proprietary (non-classified)	40-60%

Additional information: For the wording of the listed risk phrases refer to section 16.

4 First Aid Measures

4.1 Description of first aid measures

General information:

Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and SDS to health professional with contaminated individual.

After inhalation:

Supply fresh air; consult doctor in case of complaints.

After skin contact:

Immediately wash with water and soap and rinse thoroughly. If skin irritation continues, consult a doctor.

After eye contact:
Remove contact lenses if worn. Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.

After swallowing:
Rinse out mouth and then drink plenty of water. Do not induce vomiting; call for medical help immediately.

4.2 Most important symptoms and effects, both acute and delayed:
No additional information available.

4.3 Indication of any immediate medical attention and special treatment needed:
No additional information available.

5 Firefighting Measures

5.1 Extinguishing media:
Suitable extinguishing agents:
CO2, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.

5.2 Special hazards arising from the substance or mixture:
No additional information available.

5.3 Advice for firefighters:
Protective equipment:
Wear self-contained respiratory protective device.
Wear fully protective suit.

6 Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures:
Product forms slippery surface when combined with water.

6.2 Environmental precautions:
Do not allow product to reach sewage system or any water course.

6.3 Methods and material for containment and cleaning up:
Pick up mechanically.
Clean the affected area carefully; suitable cleaners are: Warm water

6.4 Reference to other sections:
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information

7 Handling and Storage

7.1 Precautions for safe handling:
Ensure good ventilation/exhaustion at the workplace.
Keep receptacles tightly sealed.
Prevent formation of dust.
Information about fire - and explosion protection: No special measures required.

7.2 Conditions for safe storage, including any incompatibilities:
Storage:
Requirements to be met by storerooms and receptacles: No special requirements.
Information about storage in one common storage facility: None required.
Further information about storage conditions: Protect from humidity and water.

7.3 Specific end use(s): No additional information available.

8 Exposure Controls/Personal Protection

8.1 Control parameters

Ingredients with limit values that require monitoring at the workplace: Not required.

Additional information: The lists valid during the making were used as basis.

8.2 Exposure controls:

Personal protective equipment:

General protective and hygienic measures:

Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Avoid contact with the skin.
Avoid contact with the eyes and skin.

Respiratory protection:

Not required under normal conditions of use.
In case of brief exposure or low pollution use respiratory filter device.
In case of intensive or longer exposure use self-contained respiratory protective device.

Protection of hands:

Protective gloves

The glove material has to be impermeable and resistant to the product. Selection of the glove material should be based on the penetration time, rates of diffusion and the degradation of the glove material.

Material of gloves:

The selection of a suitable gloves does not only depend on the material, but also on the quality, and varies from manufacturer to manufacturer.

Penetration time of glove material:

The exact break through time has to be determined by the manufacturer of the protective gloves. DO NOT exceed the breakthrough time set by the Manufacturer.

For long term contact, gloves made of the following materials are considered suitable:

Butyl rubber, BR
Nitrile rubber, NBR
Natural rubber (NR)
Neoprene gloves

Eye protection:

Safety glasses

Body protection: Protective work clothing

9 Physical and Chemical Properties

9.1 Information on basic physical and chemical properties:

General Information:	
Appearance:	
Form:	Powder
Color:	White
Odor:	Odorless
Odor threshold:	Not determined.
pH-value (10 g/l) at 20°C:	9.5 (NA for Powder form)
Change in condition:	
Melting point/Melting range:	Not determined.
Boiling point/Boiling range:	Not determined.

Flash point:	Not applicable.
Flammability (solid, gaseous):	Not determined.
Ignition temperature:	Not determined.
Decomposition temperature:	Not determined.
Self-igniting:	Product is notselfigniting.
Danger of explosion:	Product does not present an explosion hazard.
Explosion limits:	
Lower:	Not determined.
Upper:	Not determined.
Vapor pressure:	Not applicable.
Density at 20°C:	1,1 g/cm³
Relative density:	Not determined.
Vapor density:	Not applicable.
Evaporation rate:	Not applicable.
Solubility in / Miscibility with water:	Soluble.
Segregation coefficient (n-octanol/water):	Not determined.
Viscosity:	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
Solvent content:	
Organic solvents:	0.0 %
Solids content:	100 %
9.2 Other information:	No additional information available.

10 Stability and Reactivity

10.1 Reactivity:

10.2 Chemical stability:

Thermal decomposition / conditions to be avoided:

No decomposition if used according to specifications.

10.3 Possibility of hazardous reactions:

Reacts with acids.
Reacts with strong alkali.
Reacts with strong oxidizing agents.

10.4 Conditions to avoid:

No additional information available.

10.5 Incompatible materials:

No additional information available.

10.6 Hazardous decomposition products:

Carbon monoxide and carbon dioxide
Phosphorus compounds
Sulphur oxides (SOx)

11 Toxicological Information

11.1 Information on toxicological effects:

Toxicity data: No additional information available.

Primary irritant effect:

On the skin: Irritating to skin and mucous membranes.

On the eye: Strong irritant with the danger of severe eye injury.

Sensitization: No sensitizing effects known.

Additional toxicological information:

The product shows the following dangers according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version: Irritant.

Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation ofesophagus and stomach.

12 Ecological Information

12.1 Toxicity:

Aquatic toxicity: No additional information available.

12.2 Persistence and degradability: No additional information available.

12.3 Bioaccumulative potential: Not worth-mentioning accumulating in organisms.

12.4 Mobility in soil: No additional information available.

Ecotoxical effects:

Remark: Harmful to fish

Additional ecological information:

General notes:

Water hazard class 2 (German Regulation) (Self-assessment): hazardous for water.
Do not allow product to reach ground water, water course or sewage system.
Danger to drinking water if even small quantities leak into the ground.

12.5 Results of PBT and vPvB assessment:

PBT: Not applicable.

vPvB: Not applicable.

12.6 Other adverse effects: No additional information available.

13 Disposal Considerations

13.1 Waste treatment methods:

Recommendation:

Smaller quantities can be disposed of with household waste.

Small amounts may be diluted with plenty of water and washed away. Dispose of bigger amounts in accordance with Local Authority requirements.

The surfactant used in this product complies with the biodegradability criteria as laid down in Regulation (EC) No. 648/2004 on detergents. Data to support this assertion are held at the disposal of the competent authorities of the Member States and will be made available to them, at their direct request or at the request of a detergent manufacturer.

Uncleaned packaging:

Recommendation: Disposal must be made according to official regulations.

Recommended cleansing agents: Water, together with cleansing agents, if necessary.

14 Transport Information

14.1 UN-Number:	
DOT, ADR, ADN, IMDG, IATA:	Not Regulated
14.2 UN proper shipping name:	
DOT, ADR, IMDG, IATA:	Not Regulated
14.3 Transport hazard class(es):	
DOT, ADR, IMDG, IATA:	
Class:	Not Regulated
Label:	-
14.4 Packing group:	
DOT, ADR, IMDG, IATA:	Not Regulated

14.5 Environmental hazards:

Marine pollutant: No

14.6 Special precautions for user: Not applicable.

14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.

UN "Model Regulation": Not Regulated

15 Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:

United States (USA):

SARA:

Section 355 (extremely hazardous substances): None of the ingredient is listed.

Section 313 (Specific toxic chemical listings): None of the ingredient is listed.

TSCA(Toxic Substances Control Act): All ingredients are listed.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredient is listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredient is listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredient is listed.

Chemicals known to cause developmental toxicity: None of the ingredient is listed.

Carcinogenic Categories:

EPA (Environmental Protection Agency): None of the ingredient is listed.

TLV (Threshold Limit Value established by ACGIH): None of the ingredient is listed.

NIOSH-Ca (National Institute for Occupational Safety and Health): None of the ingredient is listed.

OSHA-Ca (Occupational Safety & Health Administration): None of the ingredient is listed.

Canadá:

Canadian Domestic Substances List (DSL): All ingredients are listed.

Canadian Ingredient Disclosure list (limit 0.1%): None of the ingredient is listed.

Canadian Ingredient Disclosure list (limit 1%):

497-19-8	Sodium Carbonate
7722-88-5	Tetrasodium pyrophosphate
151-21-3	Sodium dodecyl sulphate

15.2 Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

16 Other Information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

Relevant phrases:

H320: Causes eye irritation.

Abbreviations and Acronyms:

ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road.
IMDG: International Maritime Code for Dangerous Goods.
DOT: US Department of Transportation.
IATA: International Air Transport Association.
GHS: Globally Harmonized System of Classification and Labelling of Chemicals.
ACGIH: American Conference of Governmental Industrial Hygienists.
NFPA: National Fire Protection Association (USA).
HMIS: Hazardous Materials Identification System (USA).
WHMIS: Workplace Hazardous Materials Information System (Canada).
VOC: Volatile Organic Compounds (USA, EU).
LC50: Lethal concentration, 50 percent.
LD50: Lethal dose, 50 percent.

SDS Created by:

Global Safety Management, Inc.
10006 Cross Creek Blvd
Tampa, FL, 33647
Tel: 1-844-GSM-INFO (1-844-476-4636)
Website: www.GSMSDS.com

LabChem
performance through chemistry

Hydrochloric Acid, 37% w/w

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations
Date of issue: 08/16/1998 Revision date: 05/05/2014 Supersedes: 07/03/2013 Version: 1.1

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Substance
Substance name : Hydrochloric Acid, 37% w/w
CAS No : 7647-01-0
Product code : LC14950
Formula : HCl
Synonyms : Hydrochloric acid / hydrochloric acid, conc=37%, aqueous solution
BIG no : 29443

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Laboratory chemical

1.3. Details of the supplier of the safety data sheet

LabChem Inc
Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
Zelienople, PA 16063 - USA
T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or 011-703-527-3887

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

GHS-US classification

Acute Tox. 4 (Oral)	H302
Skin Corr. 1B	H314
Eye Dam. 1	H318
STOT SE 3	H335
Aquatic Acute 3	H402

2.2. Label elements

GHS-US labelling

Hazard pictograms (GHS-US) :


GHS05


GHS07

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) :
H302 - Harmful if swallowed
H314 - Causes severe skin burns and eye damage
H335 - May cause respiratory irritation
H402 - Harmful to aquatic life

Precautionary statements (GHS-US) :
P260 - Do not breathe mist, spray, vapours
P264 - Wash exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P271 - Use only outdoors or in a well-ventilated area
P273 - Avoid release to the environment
P280 - Wear eye protection, face protection, protective clothing, protective gloves
P301+P330+P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting
P303+P361+P353 - IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
P304+P340 - IF INHALED: remove victim to fresh air and keep at rest in a position comfortable for breathing
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P310 - Immediately call a POISON CENTER or doctor/physician
P363 - Wash contaminated clothing before reuse

P403+P233 - Store in a well-ventilated place. Keep container tightly closed
P405 - Store locked up
P501 - Dispose of contents/container to Comply with applicable regulations

2.3. Other hazards

Other hazards not contributing to the classification : None under normal conditions.

2.4. Unknown acute toxicity (GHS-US)

No data available

SECTION 3: Composition/information on ingredients

3.1. Substance

Substance type : Multi-constituent
Name : Hydrochloric Acid, 37% w/w
CAS No : 7647-01-0

Name	Product identifier	%	GHS-US classification
Water	(CAS No) 7732-18-5	63	Not classified
Hydrogen Chloride	(CAS No) 7647-01-0	37	Compressed gas, H280 Acute Tox. 3 (Inhalation), H331 Skin Corr. 1A, H314

Full text of H-phrases: see section 16

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Check the vital functions. Unconscious: maintain adequate airway and respiration. Respiratory arrest: artificial respiration or oxygen. Cardiac arrest: perform resuscitation. Victim conscious with laboured breathing: half-seated. Victim in shock: on his back with legs slightly raised. Vomiting: prevent asphyxia/aspiration pneumonia. Prevent cooling by covering the victim (no warming up). Keep watching the victim. Give psychological aid. Keep the victim calm, avoid physical strain. Depending on the victim's condition: doctor/hospital.

First-aid measures after inhalation : Remove the victim into fresh air. Respiratory problems: consult a doctor/medical service.

First-aid measures after skin contact : Wash immediately with PE-glycol 400. Wash immediately with lots of water (15 minutes)/shower. Remove clothing while washing. Do not remove clothing if it sticks to the skin. Cover wounds with sterile bandage. Consult a doctor/medical service. If burned surface > 10%: take victim to hospital.

First-aid measures after eye contact : Rinse immediately with plenty of water for 15 minutes. Do not apply neutralizing agents. Take victim to an ophthalmologist.

First-aid measures after ingestion : Rinse mouth with water. Immediately after ingestion: give lots of water to drink. Do not induce vomiting. Immediately consult a doctor/medical service. Call Poison Information Centre (www.big.be/antigif.htm). Take the container/vomit to the doctor/hospital. Do not give chemical antidote. Ingestion of large quantities: immediately to hospital.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries after inhalation : Dry/sore throat. Coughing. Irritation of the respiratory tract. Irritation of the nasal mucous membranes. EXPOSURE TO HIGH CONCENTRATIONS: Respiratory difficulties. Possible laryngeal spasm/oedema. Corrosion of the upper respiratory tract. FOLLOWING SYMPTOMS MAY APPEAR LATER: Risk of pneumonia. Risk of lung oedema.

Symptoms/injuries after skin contact : Caustic burns/corrosion of the skin.

Symptoms/injuries after eye contact : Corrosion of the eye tissue. Permanent eye damage.

Symptoms/injuries after ingestion : Burns to the gastric/intestinal mucosa. Blood in vomit. Possible esophageal perforation. Shock.

4.3. Indication of any immediate medical attention and special treatment needed

Obtain medical assistance.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : EXTINGUISHING MEDIA FOR SURROUNDING FIRES: All extinguishing media allowed.

Unsuitable extinguishing media : No unsuitable extinguishing media known.

5.2. Special hazards arising from the substance or mixture

Fire hazard	:	DIRECT FIRE HAZARD. Non combustible. INDIRECT FIRE HAZARD. Reactions involving a fire hazard: see "Reactivity Hazard".
Explosion hazard	:	INDIRECT EXPLOSION HAZARD. Reactions with explosion hazards: see "Reactivity Hazard".
Reactivity	:	Decomposes on exposure to temperature rise: release of (highly) toxic gases/vapours (chlorine). On exposure to air: release of corrosive mist. Reacts violently with (some) bases. Reacts exothermically with many compounds. Reacts with (strong) oxidizers: release of (highly) toxic gases/vapours (chlorine). Reacts with (some) metals: release of highly flammable gases/vapours (hydrogen).

5.3. Advice for firefighters

Precautionary measures fire	:	Exposure to fire/heat: keep upwind. Exposure to fire/heat: consider evacuation. Exposure to fire/heat: seal off low-lying areas. Exposure to fire/heat: have neighbourhood close doors and windows.
Firefighting instructions	:	Dilute toxic gases with water spray. Take account of toxic fire-fighting water. Use water moderately and if possible collect or contain it.
Protection during firefighting	:	Heat/fire exposure: compressed air/oxygen apparatus.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment	:	Gloves. Face-shield. Corrosion-proof suit. Large spills/in enclosed spaces: compressed air apparatus. Large spills/in enclosed spaces: gas-tight suit. Reactivity hazard: compressed air/oxygen apparatus. Reactivity hazard: gas-tight suit.
Emergency procedures	:	Mark the danger area. No naked flames. In case of hazardous reactions: keep upwind. In case of reactivity hazard: consider evacuation. Large spills/in confined spaces: consider evacuation. Wash contaminated clothes.

6.1.2. For emergency responders

Protective equipment	:	Equip cleanup crew with proper protection.
Emergency procedures	:	Stop leak if safe to do so. Ventilate area.

6.2. Environmental precautions

Prevent soil and water pollution. Prevent spreading in sewers.

6.3. Methods and material for containment and cleaning up

For containment	:	Contain released substance, pump into suitable containers. Consult "Material-handling" to select material of containers. Plug the leak, cut off the supply. Dam up the liquid spill. Hazardous reaction: measure explosive gas-air mixture. If reacting: dilute combustible/toxic gases/vapours. Take account of toxic/corrosive precipitation water. Heat exposure: dilute toxic gas/vapour with water spray.
Methods for cleaning up	:	Liquid spill: neutralize with soda (sodium carbonate). Neutralized substance: take up in absorbent material. Scoop absorbed substance into closing containers. Damaged/cooled tanks must be emptied. Carefully collect the spill/leftovers. Take collected spill to manufacturer/competent authority. Clean contaminated surfaces with an excess of water. Wash clothing and equipment after handling.

6.4. Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling	:	Comply with the legal requirements. Remove contaminated clothing immediately. Clean contaminated clothing. Thoroughly clean/dry the installation before use. Do not discharge the waste into the drain. Keep away from naked flames/heat. Observe strict hygiene. Keep container tightly closed. Measure the concentration in the air regularly. Carry operations in the open/under local exhaust/ventilation or with respiratory protection.
Hygiene measures	:	Do not eat, drink or smoke when using this product. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Wash contaminated clothing before reuse.

7.2. Conditions for safe storage, including any incompatibilities

Incompatible products	:	Strong bases. metals. cyanides.
Storage temperature	:	2 - 25 °C

Heat and ignition sources	:	KEEP SUBSTANCE AWAY FROM: heat sources.
Prohibitions on mixed storage	:	KEEP SUBSTANCE AWAY FROM: oxidizing agents. (strong) bases. metals. amines.
Storage area	:	Ventilation at floor level. Keep locked up. Provide for a tub to collect spills. Meet the legal requirements.
Special rules on packaging	:	SPECIAL REQUIREMENTS: closing. corrosion-proof. clean. correctly labelled. meet the legal requirements. Secure fragile packagings in solid containers.
Packaging materials	:	MATERIAL TO AVOID: steel. metal.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Hydrochloric Acid, 37% w/w (7647-01-0)		
USA ACGIH	ACGIH Ceiling (mg/m³)	2.98 mg/m³
USA ACGIH	ACGIH Ceiling (ppm)	2 ppm
USA OSHA	OSHA PEL (Ceiling) (mg/m³)	7 mg/m³
USA OSHA	OSHA PEL (Ceiling) (ppm)	5 ppm

Hydrogen Chloride (7647-01-0)		
USA ACGIH	ACGIH Ceiling (mg/m³)	2.98 mg/m³
USA ACGIH	ACGIH Ceiling (ppm)	2 ppm
USA OSHA	OSHA PEL (Ceiling) (mg/m³)	7 mg/m³
USA OSHA	OSHA PEL (Ceiling) (ppm)	5 ppm

8.2. Exposure controls

Appropriate engineering controls	:	Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Materials for protective clothing	:	GIVE GOOD RESISTANCE: natural rubber. nitrile rubber.
Hand protection	:	Gloves.
Eye protection	:	Face shield.
Skin and body protection	:	Corrosion-proof clothing.
Respiratory protection	:	Gas mask with filter type B. Gas mask with filter type E. High vapour/gas concentration: self-contained respirator.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Liquid
Appearance	:	Liquid.
Molecular mass	:	36.46 g/mol
Colour	:	Colourless.
Odour	:	Irritating/pungent odour.
Odour threshold	:	No data available
pH	:	< 1
Relative evaporation rate (butylacetate=1)	:	No data available
Melting point	:	No data available
Freezing point	:	-30 °C
Boiling point	:	No data available
Flash point	:	Not applicable
Self ignition temperature	:	Not applicable
Decomposition temperature	:	No data available
Flammability (solid, gas)	:	No data available
Vapour pressure	:	No data available
Relative vapour density at 20 °C	:	No data available
Relative density	:	1.2

Density	: 1190 kg/m^3
Solubility	: Soluble in water. Water: Complete
Log Pow	: 0.25 (QSAR)
Log Kow	: No data available
Viscosity, kinematic	: No data available
Viscosity, dynamic	: 0.0023 Pa.s (15 °C)
Explosive properties	: Not applicable.
Oxidising properties	: None.
Explosive limits	: No data available

9.2. Other information

Minimum ignition energy	: Not applicable
VOC content	: Not applicable
Other properties	: Gas/vapour heavier than air at 20°C. Producing fumes/mist. Substance has acid reaction.

SECTION 10: Stability and reactivity

10.1. Reactivity

Decomposes on exposure to temperature rise: release of (highly) toxic gases/vapours (chlorine). On exposure to air: release of corrosive mist. Reacts violently with (some) bases. Reacts exothermically with many compounds. Reacts with (strong) oxidizers: release of (highly) toxic gases/vapours (chlorine). Reacts with (some) metals: release of highly flammable gases/vapours (hydrogen).

10.2. Chemical stability

No data available.

10.3. Possibility of hazardous reactions

Reacts violently with (some) bases: release of heat.

10.4. Conditions to avoid

Incompatible materials.

10.5. Incompatible materials

Strong bases. metals. cyanides. silver nitrate.

10.6. Hazardous decomposition products

Hydrogen chloride.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity	: Harmful if swallowed.

Hydrochloric Acid, 37% w/w (\f)7647-01-0	
LD50 oral rat	700 mg/kg
LD50 dermal rabbit	5010 mg/kg

Hydrogen Chloride (7647-01-0)	
ATE (gases)	700.000 ppmV/4h

Water (7732-18-5)	
LD50 oral rat	≥ 90000 mg/kg

Skin corrosion/irritation	: Causes severe skin burns and eye damage. pH: < 1
Serious eye damage/irritation	: Causes serious eye damage. pH: < 1
Respiratory or skin sensitisation	: Not classified
Germ cell mutagenicity	: Not classified
Carcinogenicity	: Not classified

Hydrochloric Acid, 37% w/w (7647-01-0)	
IARC group	3 - Not classifiable

Reproductive toxicity	: Not classified

Specific target organ toxicity (single exposure)	:	May cause respiratory irritation.
Specific target organ toxicity (repeated exposure)	:	Not classified
Aspiration hazard	:	Not classified
Symptoms/injuries after inhalation	:	Dry/sore throat. Coughing. Irritation of the respiratory tract. Irritation of the nasal mucous membranes. EXPOSURE TO HIGH CONCENTRATIONS: Respiratory difficulties. Possible laryngeal spasm/oedema. Corrosion of the upper respiratory tract. FOLLOWING SYMPTOMS MAY APPEAR LATER: Risk of pneumonia. Risk of lung oedema.
Symptoms/injuries after skin contact	:	Caustic burns/corrosion of the skin.
Symptoms/injuries after eye contact	:	Corrosion of the eye tissue. Permanent eye damage.
Symptoms/injuries after ingestion	:	Burns to the gastric/intestinal mucosa. Blood in vomit. Possible esophageal perforation. Shock.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - water	:	Mild water pollutant (surface water). Ground water pollutant. Maximum concentration in drinking water: 250 mg/l (chloride) (Directive 98/83/EC). Slightly harmful to fishes. Toxic to plankton. pH shift. Insufficient data available on ecotoxicity.

Hydrochloric Acid, 37% w/w (7647-01-0)	
LC50 fishes 1	282 mg/l (96 h; Gambusia affinis; Pure substance)
EC50 Daphnia 1	< 56 mg/l (72 h; Daphnia magna; Pure substance)
LC50 fish 2	862 mg/l (Leuciscus idus; Pure substance)
TLM fish 1	282 ppm (96 h; Gambusia affinis; Pure substance)

12.2. Persistence and degradability

Hydrochloric Acid, 37% w/w (7647-01-0)	
Persistence and degradability	Biodegradability: not applicable. No (test)data on mobility of the components of the mixture available.
Biochemical oxygen demand (BOD)	Not applicable
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

Water (7732-18-5)	
Persistence and degradability	Not established.

12.3. Bioaccumulative potential

Hydrochloric Acid, 37% w/w (7647-01-0)	
Log Pow	0.25 (QSAR)
Bioaccumulative potential	Low potential for bioaccumulation (Log Kow < 4).

Water (7732-18-5)	
Bioaccumulative potential	Not established.

12.4. Mobility in soil

Hydrochloric Acid, 37% w/w (7647-01-0)	
Ecology - soil	May be harmful to plant growth, blooming and fruit formation.

12.5. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations	:	Remove waste in accordance with local and/or national regulations. Hazardous waste shall not be mixed together with other waste. Different types of hazardous waste shall not be mixed together if this may entail a risk of pollution or create problems for the further management of the waste. Hazardous waste shall be managed responsibly. All entities that store, transport or handle hazardous waste shall take the necessary measures to prevent risks of pollution or damage to people or animals. Recycle by distillation. Dehydrate/make insoluble. Immobilize the toxic or harmful components. Remove to an authorized dump (Class I). Treat using the best available techniques before discharge into drains or the aquatic environment.

Additional information : LWCA (the Netherlands): KGA category 01. Hazardous waste according to Directive 2008/98/EC.

SECTION 14: Transport information

In accordance with DOT

Transport document description : UN1789 Hydrochloric acid, 8, II

UN-No.(DOT) : 1789

DOT NA no. : UN1789

DOT Proper Shipping Name : Hydrochloric acid

Department of Transportation (DOT) Hazard Classes : 8 - Class 8 - Corrosive material 49 CFR 173.136

Hazard labels (DOT) : 8 - Corrosive

Packing group (DOT) : II - Medium Danger

DOT Special Provisions (49 CFR 172.102) : A3 - For combination packagings, if glass inner packagings (including ampoules) are used, they must be packed with absorbent material in tightly closed metal receptacles before packing in outer packagings.
A6 - For combination packagings, if plastic inner packagings are used, they must be packed in tightly closed metal receptacles before packing in outer packagings.
B3 - MC 300, MC 301, MC 302, MC 303, MC 305, and MC 306 and DOT 406 cargo tanks and DOT 57 portable tanks are not authorized.
B15 - Packagings must be protected with non-metallic linings impervious to the lading or have a suitable corrosion allowance.
IB2 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized.
N41 - Metal construction materials are not authorized for any part of a packaging which is normally in contact with the hazardous material.
T8 - 4 178.274(d)(2) Normal............ Prohibited
TP2 - a. The maximum degree of filling must not exceed the degree of filling determined by the following: (image) Where: tr is the maximum mean bulk temperature during transport, tf is the temperature in degrees celsius of the liquid during filling, and a is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (tf) and the maximum mean bulk temperature during transportation (tr) both in degrees celsius. b. For liquids transported under ambient conditions may be calculated using the formula: (image) Where: d15 and d50 are the densities (in units of mass per unit volume) of the liquid at 15 C (59 F) and 50 C (122 F), respectively.
TP12 - This material is considered highly corrosive to steel.

DOT Packaging Exceptions (49 CFR 173.xxx) : 154

DOT Packaging Non Bulk (49 CFR 173.xxx) : 202

DOT Packaging Bulk (49 CFR 173.xxx) : 242

DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27) : 1 L

DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75) : 30 L

DOT Vessel Stowage Location : C - The material must be stowed ‘‘on deck only’’ on a cargo vessel and on a passenger vessel.

Additional information

Other information : No supplementary information available.

State during transport (ADR-RID) : as liquid.

ADR

Transport document description : UN 1789 Hydrochloric acid, 8, II, (E)

Packing group (ADR) : II

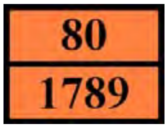
Class (ADR) : 8 - Corrosive substances

Hazard identification number (Kemler No.) : 80

Classification code (ADR) : C1

Danger labels (ADR) : 8 - Corrosive substances

Orange plates :



Tunnel restriction code : E

Transport by sea

UN-No. (IMDG) : 1789
Class (IMDG) : 8 - Corrosive substances
EmS-No. (1) : F-A
EmS-No. (2) : S-B

Air transport

UN-No.(IATA) : 1789
Class (IATA) : 8 - Corrosives
Packing group (IATA) : II - Medium Danger

SECTION 15: Regulatory information

15.1. US Federal regulations

Hydrochloric Acid, 37% w/w (7647-01-0)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
RQ (Reportable quantity, section 304 of EPA's List of Lists) :	5000 lb
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard

Water (7732-18-5)
Listed on the United States TSCA (Toxic Substances Control Act) inventory

15.2. International regulations

CANADA

Hydrochloric Acid, 37% w/w (7647-01-0)	
Listed on the Canadian DSL (Domestic Sustances List) inventory.	
WHMIS Classification	Class E - Corrosive Material

Water (7732-18-5)	
Listed on the Canadian DSL (Domestic Sustances List) inventory.	
WHMIS Classification	Uncontrolled product according to WHMIS classification criteria

EU-Regulations

No additional information available

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Skin Corr. 1B	H314
STOT SE 3	H335

Full text of H-phrases: see section 16

Classification according to Directive 67/548/EEC or 1999/45/EC

C; R34
Xi; R37

Full text of R-phrases: see section 16

15.2.2. National regulations

Hydrochloric Acid, 37% w/w (7647-01-0)
Listed on the Canadian Ingredient Disclosure List

Water (7732-18-5)
Not listed on the Canadian Ingredient Disclosure List

15.3. US State regulations

No additional information available

SECTION 16: Other information

Full text of H-phrases: see section 16:

Acute Tox. 3 (Inhalation)	Acute toxicity (inhal.), Category 3
Acute Tox. 4 (Oral)	Acute toxicity (oral), Category 4
Aquatic Acute 3	Hazardous to the aquatic environment — AcuteHazard, Category 3
Compressed gas	Gases under pressure Compressed gas
Eye Dam. 1	Serious eye damage/eye irritation, Category 1
Skin Corr. 1A	Skin corrosion/irritation, Category 1A
Skin Corr. 1B	Skin corrosion/irritation, Category 1B
STOT SE 3	Specific target organ toxicity — Single exposure, Category 3, Respiratory tract irritation
H280	Contains gas under pressure; may explode if heated
H302	Harmful if swallowed
H314	Causes severe skin burns and eye damage
H318	Causes serious eye damage
H331	Toxic if inhaled
H335	May cause respiratory irritation
H402	Harmful to aquatic life

NFPA health hazard	: 3 - Short exposure could cause serious temporary or residual injury even though prompt medical attention was given.
NFPA fire hazard	: 0 - Materials that will not burn.
NFPA reactivity	: 1 - Normally stable, but can become unstable at elevated temperatures and pressures or may react with water with some release of energy, but not violently.

HMIS III Rating

Health	: 3 Serious Hazard - Major injury likely unless prompt action is taken and medical treatment is given
Flammability	: 0 Minimal Hazard
Physical	: 1 Slight Hazard
Personal Protection	: H

SDS US (GHS HazCom 2012)

Information in this SDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc assumes no liability resulting from the use of this SDS. The user must determine suitability of this information for his application.

Material Safety Data Sheet

Creation Date 12-Mar-2009 **Revision Date** 27-Sep-2011 **Revision Number** 3

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name	**Nitric acid, Trace Metal Grade**
Cat No.	**A509-212; A509-500; A509P212; A509P500; A509SK212**
Synonyms	Azotic acid; Engraver's acid; Aqua fortis
Recommended Use	Laboratory chemicals

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. HAZARDS IDENTIFICATION

DANGER!

Emergency Overview

Oxidizer: Contact with combustible/organic material may cause fire. Causes severe burns by all exposure routes. May cause pulmonary edema.

Appearance Clear Colorless, Light yellow **Physical State** Liquid **odor** strong Acrid

Target Organs	Eyes, Respiratory system, Skin, Teeth, Kidney, Gastrointestinal tract (GI)

Potential Health Effects

Acute Effects
Principle Routes of Exposure

Eyes	Causes severe burns. May cause blindness or permanent eye damage.
Skin	Causes severe burns. May be harmful in contact with skin.
Inhalation	Causes severe burns. May cause pulmonary edema. May be harmful if inhaled.
Ingestion	Ingestion causes burns of the upper digestive and respiratory tract. May be harmful if swallowed.
Chronic Effects	Chronic exposure to corrosive fumes/gases may cause erosion of the teeth followed by jaw necrosis. Bronchial irritation with chronic cough and frequent attacks of pneumonia are common. Gastrointestinal disturbances may also be seen. May cause adverse kidney effects. Experiments have shown reproductive toxicity effects on laboratory animals.

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions	Preexisting eye disorders. Skin disorders.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Haz/Non-haz

Component	CAS-No	Weight %
Nitric acid	7697-37-2	65 - 70
Water	7732-18-5	30 - 35

4. FIRST AID MEASURES

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.
Inhalation	Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Immediate medical attention is required.
Ingestion	Do not induce vomiting. Call a physician or Poison Control Center immediately.
Notes to Physician	Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flash Point	Not applicable
Method	No information available.
Autoignition Temperature	No information available.
Explosion Limits	
Upper	No data available
Lower	No data available
Suitable Extinguishing Media	Substance is nonflammable; use agent most appropriate to extinguish surrounding fire..
Unsuitable Extinguishing Media	No information available.
Hazardous Combustion Products	No information available.
Sensitivity to mechanical impact	No information available.
Sensitivity to static discharge	No information available.

Specific Hazards Arising from the Chemical
Oxidizer: Contact with combustible/organic material may cause fire. Corrosive Material. Causes severe burns by all exposure routes. Thermal decomposition can lead to release of irritating gases and vapors.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear

NFPA	**Health** 4	**Flammability** 0	**Instability** 0	**Physical hazards** OX

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions	Wear self-contained breathing apparatus and protective suit. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Do not get in eyes, on skin, or on clothing.
Environmental Precautions	Should not be released into the environment.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable and closed containers for disposal. Keep away from clothing and other combustible materials.

7. HANDLING AND STORAGE

Handling	Use only under a chemical fume hood. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Keep away from clothing and other combustible materials. Do not breathe vapors/dust. Do not ingest. Contents under pressure.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Do not store near combustible materials

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Measures	Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location.

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Nitric acid	TWA: 2 ppm STEL: 4 ppm	(Vacated) TWA: 2 ppm (Vacated) TWA: 5 mg/m^3 (Vacated) STEL: 4 ppm (Vacated) STEL: 10 mg/m^3 TWA: 2 ppm TWA: 5 mg/m^3	IDLH: 25 ppm TWA: 2 ppm TWA: 5 mg/m^3 STEL: 4 ppm STEL: 10 mg/m^3

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Nitric acid	TWA: 2 ppm TWA: 5.2 mg/m^3 STEL: 4 ppm STEL: 10 mg/m^3	TWA: 2 ppm TWA: 5 mg/m^3 STEL: 4 ppm STEL: 10 mg/m^3	TWA: 2 ppm STEL: 4 ppm

NIOSH IDLH: *Immediately Dangerous to Life or Health*

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquid
Appearance	Clear Colorless, Light yellow
odor	strong Acrid
Odor Threshold	No information available.
pH	1.0 (0.1M)
Vapor Pressure	0.94 kPa (20°C)
Vapor Density	No information available.
Viscosity	No information available.
Boiling Point/Range	120.5°C / 248.9°F
Melting Point/Range	-41°C / -41.8°F
Decomposition temperature	No information available.
Flash Point	Not applicable
Evaporation Rate	No information available.
Specific Gravity	1.40
Solubility	No information available.
log Pow	No data available
Molecular Weight	63.02
Molecular Formula	HNO_3

10. STABILITY AND REACTIVITY

Stability	Oxidizer: Contact with combustible/organic material may cause fire.
Conditions to Avoid	Incompatible products. Combustible material. Excess heat.
Incompatible Materials	Strong bases, Reducing agents, Organic materials, Aldehydes, Alcohols, Cyanides, Metals, Powdered metals, Ammonia
Hazardous Decomposition Products	Nitrogen oxides (NOx)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions .	None under normal processing..

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Nitric acid	Not listed	Not listed	130 mg/m^3 (Rat) 4 h 7 mg/L (Rat) 1 h

Irritation Causes severe burns by all exposure routes

Toxicologically Synergistic Products No information available.

Chronic Toxicity

Carcinogenicity There are no known carcinogenic chemicals in this product

Sensitization No information available.

Mutagenic Effects No information available.

Reproductive Effects Experiments have shown reproductive toxicity effects on laboratory animals.

Developmental Effects No information available.

Teratogenicity Teratogenic effects have occurred in experimental animals..

Other Adverse Effects See actual entry in RTECS for complete information.

Endocrine Disruptor Information No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity

Do not empty into drains.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Nitric acid	Not listed	72 mg/L LC50 96 h	Not listed	Not listed

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available

Mobility .

Component	log Pow
Nitric acid	-2.3

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. TRANSPORT INFORMATION

DOT

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

TDG

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IATA

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IMDG/IMO

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

15. REGULATORY INFORMATION

All of the components in the product are on the following Inventory lists:

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	CHINA	KECL
Nitric acid	X	X	-	231-714-2	-		X	X	X	X	X
Water	X	X	-	231-791-2	-		X	-	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Nitric acid	7697-37-2	65 - 70	1.0

SARA 311/312 Hazardous Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	Yes

Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Nitric acid	X	1000 lb	-	-

Clean Air Act

Not applicable

OSHA

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Nitric acid	-	TQ: 500 lb

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Nitric acid	1000 lb	1000 lb

California Proposition 65

This product does not contain any Proposition 65 chemicals.

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Nitric acid	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security

This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Nitric acid	2000 lb STQ

Other International Regulations

Mexico - Grade	No information available

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class

C Oxidizing materials
E Corrosive material

16. OTHER INFORMATION

Prepared By	Regulatory Affairs Thermo Fisher Scientific Tel: (412) 490-8929
Creation Date	12-Mar-2009
Print Date	27-Sep-2011
Revision Summary	(M)SDS sections updated 3

Disclaimer

End of MSDS

Sulfuric Acid, 96% w/w

Safety Data Sheet 75289

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 10/01/1998 Revision date: 06/27/2013 Supersedes: 01/25/2012 Version: 1.0

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Substance
Substance name : Sulfuric Acid, 96% w/w
CAS No : 7664-93-9
Product code : LC25550
Formula : H_2SO_4
Synonyms : battery acid / brown acid / brown oil of vitriol / dihydrogen sulfate / dipping acid / electrolyte acid / nordhausen acid / oil of vitriol / sulphuric acid
BIG no : 14049

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Industrial use
Laboratory chemical
Battery: component

1.3. Details of the supplier of the safety data sheet

LabChem Inc
Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
Zelienople, PA 16063 - USA
T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or 011-703-527-3887

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

GHS-US classification

Skin Corr. 1A H314
Eye Dam. 1 H318

2.2. Label elements

GHS-US labelling

Hazard pictograms (GHS-US) :

GHS05

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) : H314 - Causes severe skin burns and eye damage
H318 - Causes serious eye damage

Precautionary statements (GHS-US) : P260 - Do not breathe mist, vapours, spray
P264 - Wash exposed skin thoroughly after handling
P280 - Wear protective gloves, protective clothing, eye protection, face protection
P301+P330+P331 - IF SWALLOWED: Rinse mouth. Do NOT induce vomiting
P303+P361+P353 - IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P310 - Immediately call a POISON CENTER/doctor/…
P363 - Wash contaminated clothing before reuse
P405 - Store locked up
P501 - Dispose of contents/container to comply with local, state and federal regulations

2.3. Other hazards

Other hazards not contributing to the classification : None.

2.4. Unknown acute toxicity (GHS-US)

No data available

SECTION 3: Composition/information on ingredients

3.1. Substances

Substance type : Mono-constituent

Name	Product identifier	%	GHS-US classification
Sulfuric Acid, 96% w/w (Main constituent)	(CAS No) 7664-93-9	96	Skin Corr. 1A, H314 Eye Dam. 1, H318

Full text of H-phrases: see section 16

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Check the vital functions. Unconscious: maintain adequate airway and respiration. Respiratory arrest: artificial respiration or oxygen. Cardiac arrest: perform resuscitation. Victim conscious with laboured breathing: half-seated. Victim in shock: on his back with legs slightly raised. Vomiting: prevent asphyxia/aspiration pneumonia. Prevent cooling by covering the victim (no warming up). Keep watching the victim. Give psychological aid. Keep the victim calm, avoid physical strain. Depending on the victim's condition: doctor/hospital.

First-aid measures after inhalation : Remove the victim into fresh air. Immediately consult a doctor/medical service.

First-aid measures after skin contact : Wash immediately with lots of water (15 minutes)/shower. Do not apply (chemical) neutralizing agents. Remove clothing while washing. Do not remove clothing if it sticks to the skin. Cover wounds with sterile bandage. Consult a doctor/medical service. If burned surface > 10%: take victim to hospital.

First-aid measures after eye contact : Rinse immediately with plenty of water for 15 minutes. Take victim to an ophthalmologist. Do not apply neutralizing agents.

First-aid measures after ingestion : Rinse mouth with water. Do not induce vomiting. Do not give activated charcoal. Immediately consult a doctor/medical service. Call Poison Information Centre (www.big.be/antigif.htm). Take the container/vomit to the doctor/hospital. Ingestion of large quantities: immediately to hospital. Do not give chemical antidote.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries after inhalation : Dry/sore throat. Coughing. Irritation of the respiratory tract. Irritation of the nasal mucous membranes. ON CONTINUOUS EXPOSURE/CONTACT: Corrosion of the upper respiratory tract. FOLLOWING SYMPTOMS MAY APPEAR LATER: Possible laryngeal spasm/oedema. Risk of pneumonia. Risk of lung oedema. Respiratory difficulties.

Symptoms/injuries after skin contact : Caustic burns/corrosion of the skin.

Symptoms/injuries after eye contact : Corrosion of the eye tissue. Permanent eye damage.

Symptoms/injuries after ingestion : Nausea. Abdominal pain. Blood in stool. Blood in vomit. Burns to the gastric/intestinal mucosa. AFTER ABSORPTION OF HIGH QUANTITIES: Shock.

Chronic symptoms : ON CONTINUOUS/REPEATED EXPOSURE/CONTACT: Red skin. Dry skin. Itching. Skin rash/inflammation. Affection/discolouration of the teeth. Inflammation/damage of the eye tissue.

4.3. Indication of any immediate medical attention and special treatment needed

Obtain medical assistance.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Unsuitable extinguishing media : EXTINGUISHING MEDIA FOR SURROUNDING FIRES: Water. Water spray.

5.2. Special hazards arising from the substance or mixture

Fire hazard : DIRECT FIRE HAZARD. Non combustible. INDIRECT FIRE HAZARD. Reactions involving a fire hazard: see "Reactivity Hazard".

Explosion hazard : INDIRECT EXPLOSION HAZARD. Reactions with explosion hazards: see "Reactivity Hazard".

Reactivity : Violent exothermic reaction with water (moisture): release of corrosive gases/vapours. Reacts on exposure to water (moisture) with (some) metals: release of highly flammable gases/vapours (hydrogen). On heating/burning: release of toxic and corrosive gases/vapours (sulphur oxides). Reacts violently with (some) bases: heat release resulting in increased fire or explosion risk. Reacts with many compounds e.g.: with (strong) reducers, with organic material and with combustible materials: (increased) risk of fire/explosion.

5.3. Advice for firefighters

Precautionary measures fire : Exposure to fire/heat: keep upwind. Exposure to fire/heat: consider evacuation. Exposure to fire/heat: seal off low-lying areas. Exposure to fire/heat: have neighbourhood close doors and windows.

Firefighting instructions : Cool tanks/drums with water spray/remove them into safety. When cooling/extinguishing: no water in the substance. Dilute toxic gases with water spray.

Protection during firefighting : Heat/fire exposure: compressed air/oxygen apparatus.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment	: Gloves. Face-shield. Corrosion-proof suit. Large spills/in enclosed spaces: compressed air apparatus. Large spills/in enclosed spaces: gas-tight suit.
Emergency procedures	: Mark the danger area. No naked flames. Keep containers closed. Avoid ingress of water in the containers. Wash contaminated clothes. Large spills/in confined spaces: consider evacuation. In case of hazardous reactions: keep upwind. In case of reactivity hazard: consider evacuation.

6.1.2. For emergency responders

Protective equipment	: Equip cleanup crew with proper protection.
Emergency procedures	: Stop leak if safe to do so. Ventilate area.

6.2. Environmental precautions

Prevent soil and water pollution. Prevent spreading in sewers.

6.3. Methods and material for containment and cleaning up

For containment	: Contain released substance, pump into suitable containers. Consult "Material-handling" to select material of containers. Plug the leak, cut off the supply. Dam up the liquid spill. Hazardous reaction: measure explosive gas-air mixture. Reaction: dilute combustible gas/vapour with water curtain. Take account of toxic/corrosive precipitation water. Heat exposure: dilute toxic gas/vapour with water spray.
Methods for cleaning up	: Take up liquid spill into inert absorbent material, e.g.: dry sand/earth/vermiculite. Scoop absorbed substance into closing containers. Carefully collect the spill/leftovers. Damaged/cooled tanks must be emptied. See "Material-handling" for suitable container materials. Clean contaminated surfaces with an excess of water. Take collected spill to manufacturer/competent authority. Wash clothing and equipment after handling.

6.4. Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling	: Comply with the legal requirements. Remove contaminated clothing immediately. Clean contaminated clothing. Keep the substance free from contamination. Thoroughly clean/dry the installation before use. Do not discharge the waste into the drain. Never add water to this product. Never dilute by pouring water to the acid. Always add the acid to the water. Keep away from naked flames/heat. Observe very strict hygiene - avoid contact. Keep container tightly closed. Measure the concentration in the air regularly. Carry operations in the open/under local exhaust/ventilation or with respiratory protection.
Hygiene measures	: Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Wash contaminated clothing before reuse. Do not eat, drink or smoke when using this product.

7.2. Conditions for safe storage, including any incompatibilities

Incompatible products	: Strong bases. metals. combustible materials.
Heat and ignition sources	: KEEP SUBSTANCE AWAY FROM: heat sources.
Prohibitions on mixed storage	: KEEP SUBSTANCE AWAY FROM: combustible materials. reducing agents. (strong) bases. highly flammable materials. metals. cellulosic materials. organic materials. alcohols. amines. water/moisture.
Storage area	: Store in a dry area. Ventilation at floor level. Keep locked up. Provide for a tub to collect spills. Unauthorized persons are not admitted. Meet the legal requirements.
Special rules on packaging	: SPECIAL REQUIREMENTS: closing. dry. clean. correctly labelled. meet the legal requirements. Secure fragile packagings in solid containers.
Packaging materials	: SUITABLE MATERIAL: stainless steel. carbon steel. polyethylene. polypropylene. glass. stoneware/porcelain. MATERIAL TO AVOID: monel steel. lead. copper. zinc.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Sulfuric Acid, 96% w/w (7664-93-9)		
USA ACGIH	ACGIH TWA (mg/m³)	0.2 mg/m³
USA OSHA	OSHA PEL (TWA) (mg/m³)	1 mg/m³

8.2. Exposure controls

Appropriate engineering controls	: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Provide adequate general and local exhaust ventilation.

Materials for protective clothing	:	GIVE EXCELLENT RESISTANCE: butyl rubber. polyethylene. tetrafluoroethylene. GIVE LESS RESISTANCE: neoprene. PVC. viton. GIVE POOR RESISTANCE: natural rubber. nitrile rubber. PVA.
Hand protection	:	Gloves.
Eye protection	:	Face shield.
Skin and body protection	:	Corrosion-proof clothing.
Respiratory protection	:	Gas mask with filter type E at conc. in air > exposure limit.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Liquid
Appearance	:	Liquid.
Molecular mass	:	98.08 g/mol
Colour	:	Pure substance: colourless. Unpurified: yellow to brown.
Odour	:	Almost odourless.
Odour threshold	:	> 1 mg/m^3
pH	:	No data available
Relative evaporation rate (butylacetate=1)	:	No data available
Melting point	:	10 °C
Freezing point	:	No data available
Boiling point	:	288 °C
Flash point	:	Not applicable
Self ignition temperature	:	No data available
Decomposition temperature	:	> 340 °C
Flammability (solid, gas)	:	No data available
Vapour pressure	:	< 1.0 hPa
Relative vapour density at 20 °C	:	3.4
Relative density	:	1.8
Density	:	1840 kg/m^3
Solubility	:	Exothermically soluble in water. Soluble in ethanol. Water: Complete
Log Pow	:	-2.20 (Estimated value)
Log Kow	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available
Explosive properties	:	No data available.
Oxidising properties	:	No data available.
Explosive limits	:	No data available

9.2. Other information

VOC content	:	Not applicable
Other properties	:	Gas/vapour heavier than air at 20°C. Clear. Hygroscopic. Slightly volatile. Substance has acid reaction.

SECTION 10: Stability and reactivity

10.1. Reactivity

Violent exothermic reaction with water (moisture): release of corrosive gases/vapours. Reacts on exposure to water (moisture) with (some) metals: release of highly flammable gases/vapours (hydrogen). On heating/burning: release of toxic and corrosive gases/vapours (sulphur oxides). Reacts violently with (some) bases: heat release resulting in increased fire or explosion risk. Reacts with many compounds e.g.: with (strong) reducers, with organic material and with combustible materials: (increased) risk of fire/explosion.

10.2. Chemical stability

Unstable on exposure to moisture.

10.3. Possibility of hazardous reactions

Reacts violently with water. Reacts violently with (some) bases: release of heat.

10.4. Conditions to avoid

Incompatible materials. Moisture.

10.5. Incompatible materials

Water. Strong bases. Organic compounds. metals. Halogens. cyanides. combustible materials.

10.6. Hazardous decomposition products

Sulfur compounds.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Sulfuric Acid, 96% w/w (\f)7664-93-9	
LD50 oral rat	2140 mg/kg bodyweight (Rat; Experimental value,Rat; Experimental value)

Skin corrosion/irritation : Causes severe skin burns and eye damage.
Serious eye damage/irritation : Causes serious eye damage.
Respiratory or skin sensitisation : Not classified
Germ cell mutagenicity : Not classified
Carcinogenicity : Not classified

Sulfuric Acid, 96% w/w (7664-93-9)	
IARC group	1

Reproductive toxicity : Not classified
Specific target organ toxicity (single exposure) : Not classified

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified
Symptoms/injuries after inhalation : Dry/sore throat. Coughing. Irritation of the respiratory tract. Irritation of the nasal mucous membranes. ON CONTINUOUS EXPOSURE/CONTACT: Corrosion of the upper respiratory tract. FOLLOWING SYMPTOMS MAY APPEAR LATER: Possible laryngeal spasm/oedema. Risk of pneumonia. Risk of lung oedema. Respiratory difficulties.
Symptoms/injuries after skin contact : Caustic burns/corrosion of the skin.
Symptoms/injuries after eye contact : Corrosion of the eye tissue. Permanent eye damage.
Symptoms/injuries after ingestion : Nausea. Abdominal pain. Blood in stool. Blood in vomit. Burns to the gastric/intestinal mucosa. AFTER ABSORPTION OF HIGH QUANTITIES: Shock.
Chronic symptoms : ON CONTINUOUS/REPEATED EXPOSURE/CONTACT: Red skin. Dry skin. Itching. Skin rash/inflammation. Affection/discolouration of the teeth. Inflammation/damage of the eye tissue.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : Classification concerning the environment: not applicable.
Ecology - water : Mild water pollutant (surface water). Ground water pollutant. Maximum concentration in drinking water: 250 mg/l (sulfate) (Directive 98/83/EC). Harmful to fishes. Harmful to invertebrates (Daphnia). Toxic to plankton. pH shift. Inhibition of activated sludge.

Sulfuric Acid, 96% w/w (7664-93-9)	
LC50 fishes 1	42 mg/l (96 h; Gambusia affinis)
EC50 Daphnia 1	29 mg/l (24 h; Daphnia magna)
LC50 fish 2	49 mg/l (48 h; Lepomis macrochirus)
TLM fish 1	42 mg/l (96 h; Gambusia affinis)
Threshold limit other aquatic organisms 1	6900 mg/l (24 h; Pseudomonas fluorescens)

12.2. Persistence and degradability

Sulfuric Acid, 96% w/w (7664-93-9)	
Persistence and degradability	Biodegradability: not applicable.
Biochemical oxygen demand (BOD)	Not applicable
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

12.3. Bioaccumulative potential

Sulfuric Acid, 96% w/w (7664-93-9)	
Log Pow	-2.20 (Estimated value)
Bioaccumulative potential	Bioaccumulation: not applicable.

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Remove waste in accordance with local and/or national regulations. Recycle/reuse. Remove for physico-chemical/biological treatment. Remove to an authorized dump (Class I). Treat using the best available techniques before discharge into drains or the aquatic environment. Use appropriate containment to avoid environmental contamination.

Additional information : LWCA (the Netherlands): KGA category 01. Hazardous waste according to Directive 2008/98/EC.

Ecology - waste materials : Avoid release to the environment.

SECTION 14: Transport information

In accordance with DOT

14.1. UN number

UN-No.(DOT) : 1830

DOT NA no. UN1830

14.2. UN proper shipping name

DOT Proper Shipping Name : Sulfuric acid

with more than 51 percent acid

Department of Transportation (DOT) Hazard Classes : 8 - Class 8 - Corrosive material 49 CFR 173.136

Hazard labels (DOT) : 8 - Corrosive substances

Packing group (DOT) : II - Medium Danger

DOT Special Provisions (49 CFR 172.102) : A3 - For combination packagings, if glass inner packagings (including ampoules) are used, they must be packed with absorbent material in tightly closed metal receptacles before packing in outer packagings.
A7 - Steel packagings must be corrosion-resistant or have protection against corrosion.
B3 - MC 300, MC 301, MC 302, MC 303, MC 305, and MC 306 and DOT 406 cargo tanks and DOT 57 portable tanks are not authorized.
B83 - Bottom outlets are prohibited on tank car tanks transporting sulfuric acid in concentrations over 65.25 percent.
B84 - Packagings must be protected with non-metallic linings impervious to the lading or have a suitable corrosion allowance for sulfuric acid or spent sulfuric acid in concentration up to 65.25 percent.
IB2 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized.
N34 - Aluminum construction materials are not authorized for any part of a packaging which is normally in contact with the hazardous material.
T8 - 4 178.274(d)(2) Normal............. Prohibited
TP2 - a. The maximum degree of filling must not exceed the degree of filling determined by the following: Degree of filling = 95 / (1 + a (tr - tf)) Where: tr is the maximum mean bulk temperature during transport, tf is the temperature in degrees celsius of the liquid during filling, and is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (tf) and the maximum mean bulk temperature during transportation (tr) both in degrees celsius. b. For liquids transported under ambient conditions may be calculated using the formula: a = (d15 - d50) / 35*d50 Where: d15 and d50 are the densities (in units of mass per unit volume) of the liquid at 15 C (59 F) and 50 C (122 F), respectively.
TP12 - This material is considered highly corrosive to steel.

DOT Packaging Exceptions (49 CFR 173.xxx) : 154

DOT Packaging Non Bulk (49 CFR 173.xxx) : 202

DOT Packaging Bulk (49 CFR 173.xxx) : 242

14.3. Additional information

Other information : No supplementary information available.

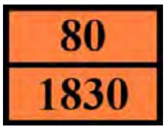
State during transport (ADR-RID) : as liquid.

Overland transport

Packing group (ADR) : II

Class (ADR) : 8 - Corrosive substances
Hazard identification number (Kemler No.) : 80
Classification code (ADR) : C1
Danger labels (ADR) : 8 - Corrosive substances

Orange plates :



Tunnel restriction code : E

Transport by sea

DOT Vessel Stowage Location : C - The material must be stowed ‘‘on deck only’’ on a cargo vessel and on a passenger vessel.
DOT Vessel Stowage Other : 14 - For metal drums, stowage permitted under deck on cargo vessels
EmS-No. (1) : F-A
EmS-No. (2) : S-B

Air transport

DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27) : 1 L
DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75) : 30 L

SECTION 15: Regulatory information

15.1. US Federal regulations

Sulfuric Acid, 96% w/w (7664-93-9)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
RQ (Reportable quantity, section 304 of EPA's List of Lists) :	1000 lb
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard

15.2. International regulations

CANADA

Sulfuric Acid, 96% w/w (7664-93-9)	
Listed on the Canadian DSL (Domestic Sustances List) inventory.	
WHMIS Classification	Class E - Corrosive Material

EU-Regulations

No additional information available

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Skin Corr. 1A H314

Full text of H-phrases: see section 16

Classification according to Directive 67/548/EEC or 1999/45/EC

C; R35

Full text of R-phrases: see section 16

15.2.2. National regulations

Sulfuric Acid, 96% w/w (7664-93-9)
Listed on the Canadian Ingredient Disclosure List

15.3. US State regulations

No additional information available

SECTION 16: Other information

Full text of H-phrases: see section 16:

Eye Dam. 1	Serious eye damage/eye irritation, Category 1
Skin Corr. 1A	Skin corrosion/irritation, Category 1A
H314	Causes severe skin burns and eye damage
H318	Causes serious eye damage

NFPA health hazard : 3 - Short exposure could cause serious temporary or residual injury even though prompt medical attention was given.

NFPA fire hazard : 0 - Materials that will not burn.

NFPA reactivity : 2 - Normally unstable and readily undergo violent decomposition but do not detonate. Also: may react violently with water or may form potentially explosive mixtures with water.

NFPA specific hazard : W - Unusual reactivity with water. This indicates a potential hazard using water to fight a fire involving this material. When a compound is both water-reactive and an oxidizer, the W/bar symbol should go in this quadrant and the OX warning is placed immediately below the NFPA diamond.

HMIS III Rating

Health : 3 Serious Hazard - Major injury likely unless prompt action is taken and medical treatment is given

Flammability : 0 Minimal Hazard

Physical : 2 Moderate Hazard

Personal Protection : H

SDS US (GHS HazCom 2012)