Final Work Plan/UFP-QAPP

Remedial Action

National Guard Federal Scout Armory

Savoonga, Alaska

ADEC File Number 670.38.002

ADEC Hazard ID 3099

Contract W911KB17D0020

June 2022

Prepared for:

U.S. Army Corps of Engineers

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Appendix C	Laboratory Certifications
Appendix D	Conceptual Site Model
Appendix E	Site Safety and Health Plan
Appendix F	Regulatory Correspondence

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
%	percent
%R	percent recovery
AAC	Alaska Administrative Code
ACL	alternative cleanup level
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
AED	automated external defibrillator
AKARNG	Alaska Army National Guard
AKCESCL	Alaska Certified Erosion and Sediment Control Lead
AOC	Area of Concern
AST	aboveground storage tank
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
Brice	Brice Engineering, LLC
BTEX	benzene, toluene, ethylbenzene, and xylenes
CCV	continuing calibration verification
CFR	Code of Federal Regulations
CL	control limit
Clarus	Clarus Environmental Services
CoC	chain-of-custody
COC	contaminant of concern
COPC	contaminant of potential concern
COR	Contracting Officer's Representative
CPR	cardiopulmonary resuscitation
CSM	conceptual site model
cy	cubic yards
DL	detection limit
DoD	U.S. Department of Defense
DQI	data quality indicator
DQO	data quality objective
DRO	diesel range organics
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ERM	Environmental Resource Management
FD	field duplicate
FID	flame ionization detector

ACRONYMS AND ABBREVIATIONS (CONTINUED)

FSA	Federal Scout Armory
GAC	granular activated carbon
GC	gas chromatography
GC/MS	gas chromatography/mass spectroscopy
GIS	geographic information system
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HAZWOPER	hazardous waste operations and emergency response
ICAL	initial calibration
ICP	inductively coupled plasma
ICV	initial calibration verification
IDQTF	Intergovernmental Data Quality Task Force
IDW	investigative-derived waste
IS	internal standard
ISO	International Organization for Standardization
LCL	lower control limit
LCL	lower confidence level
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LNAPL	light non-aqueous phase liquid
LOD	limit of detection
LOQ	limit of quantitation
LV	low volume
MB	method blank
ME	marginal exceedance
MED	Manual for Electronic Deliverables
MeOH	methanol
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter/milliliters
MPC	measurement performance criteria
MS	matrix spike
MSD	matrix spike duplicate
N/A or NA	not applicable
NAD83	North American Vertical Datum of 1983
NAVD88	North American Vertical Datum of 1988
ND	non-detect
No.	number
NS	not specified

ACRONYMS AND ABBREVIATIONS (CONTINUED)

OSHA	U.S. Occupational Safety and Health Administration
oz	ounce
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PAL	project action limit
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PID	photoionization detector
POA	Pacific Ocean/Alaska
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
QAM	Quality Assurance Manual
QC	quality control
QSM	Quality Systems Manual
RA	remedial action
RCRA	Resource Conservation and Recovery Act
RF	response factor
RI	remedial investigation
RPD	relative percent difference
RSD	relative standard deviation
RT	retention time
RTK	Real-Time Kinematic
SDG	sample delivery group
SEDD	Staged Electronic Data Deliverable
SI	site investigation
SIM	selected ion monitoring
SME	sporadic marginal exceedance
SMS	sediment management standard
SOP	standard operating procedure
SP-16	Screen Point 16
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
TLC	Teflon-lined cap
TLS	Teflon-lined septa
TPH	total petroleum hydrocarbons
UCL	upper control limit
UFP-QAPP	Unified Federal Policy – Quality Assurance Project Plan
USACE	U.S. Army Corps of Engineers

ACRONYMS AND ABBREVIATIONS (CONTINUED)

USACE-POA	U.S. Army Corps of Engineers – Pacific Ocean, Alaska
USAEC	U.S. Army Environmental Center
VOA	volatile organic analysis
VOC	volatile organic compound
WGS84	World Geodetic System 1984

EXECUTIVE SUMMARY

This Work Plan describes the project approach and methods that will be used while conducting remedial Action (RA) activities at the Federal Scout Armory in Savoonga, Alaska during the 2022 field season (Figure 1 and Figure 2). This Work Plan was prepared by Brice Engineering, LLC (Brice) in Uniform Federal Policy - Quality Assurance Project Plan (UFP-QAPP) format in accordance with U.S. Environmental Protection Agency (EPA) guidance, 18 Alaska Administrative Code (AAC) 75 (Alaska Department of Environmental Conservation [ADEC] 2021a); the ADEC Field Sampling Guidance (ADEC 2022); the UFP-QAPP Manual (Intergovernmental Data Quality Task Force [IDQTF] 2005, 2012); and the Manual for Electronic Deliverables (MED; USACE 2017). Work will be performed for the U.S. Army Corps of Engineers (USACE), Alaska District, under Contract W911KB-17-D-0020, Task Order W911KB-18-F-0155.

In addition to the UFP-QAPP Worksheets, the following Appendices are included:

- Appendix A – Community Relations Plan
- Appendix B – Field Standard Operating Procedures (SOPs)
- Appendix C – Laboratory Certifications
- Appendix D – Conceptual Site Model
- Appendix E – Site Safety and Health Plan (SSHP)
- Appendix F – Regulatory Correspondence

In November 2018, as part of this contract, an Accident Prevention Plan (APP) was submitted and approved.

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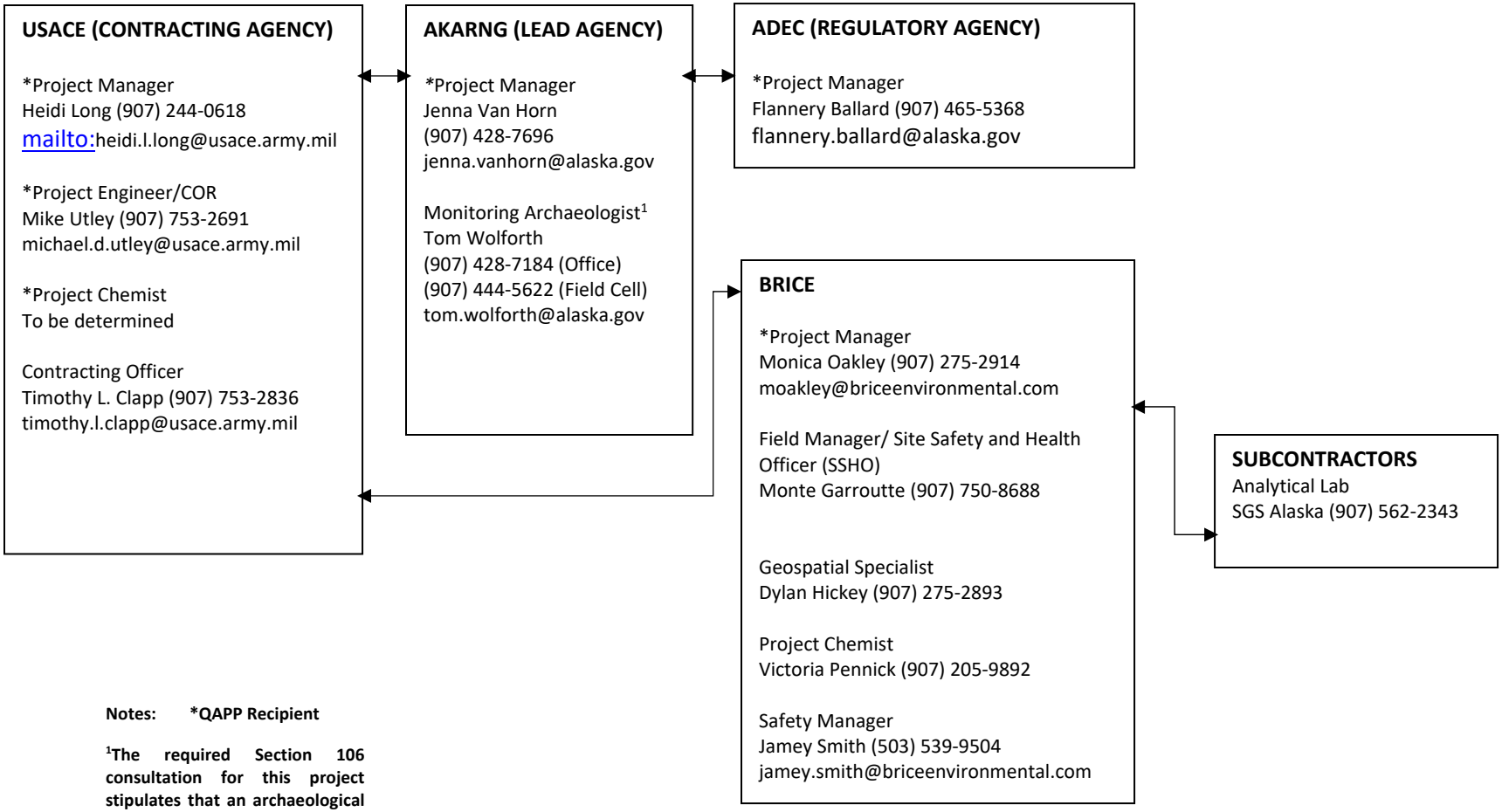
WORKSHEET 1/2 – TITLE AND APPROVAL PAGE

Project Information	
Site Name/Project Name:	Remedial Action (RA), Savoonga Federal Scout Readiness Center, Savoonga, Alaska
Site Location/Site Number:	Savoonga, Alaska
Contract Number:	W911KB-17-D-0020, Task Order W911KB-18-F-0155
Preparer's Organization	
Organization Name:	Brice Engineering, LLC (Brice)
Lead Organization Project Manager:	Monica Oakley
Signature and Date:	_____
Contracting Organization	
Organization Name:	Alaska Army National Guard (AKARNG)
Lead Organization Contracting Officer's Representative/Project Manager:	Jenna Van Horn
Signature and Date:	_____
Lead Organization	
Organization Name:	U.S. Army Corps of Engineers (USACE) – Alaska District
Lead Organization Project Manager:	Heidi Long
Signature and Date:	_____

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WORKSHEET 3/5 – PROJECT ORGANIZATIONAL CHART/QAPP DISTRIBUTION

The project organizational chart is presented below.



Notes: ***QAPP Recipient**

[1]The required Section 106 consultation for this project stipulates that an archaeological monitor will be present during all soil-disturbing activity.

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WORKSHEET 4/7/8 – PERSONNEL QUALIFICATIONS

Table 4-1 identifies key project personnel performing tasks defined in this QAPP. Resumes are available upon request. Training records and certifications for personnel and subcontractors are on file in the Brice Anchorage office.

Table 4-1 Personnel Qualifications

Title	Name	Responsibilities	Education/ Experience	Specialized Training/Certifications
Brice PM	Monica Oakley	Providing direction to the Brice project team to ensure project objectives are achieved, the project budget is tracked, and the project is on schedule.	Monica has over 16 years of experience working on State and Federal environmental projects across Alaska. She holds a BS and an MA from Washington State University and is a Project Management Professional.	• 40-hour HAZWOPER • 8-hour refresher per 29 CFR 1910.120(e) • First-aid certification • Adult CPR/AED certification • USACE Construction Quality Management for Contractors Certification • 30-hour OSHA • Alaska Certified Erosion Sediment Control Lead • Hazardous material shipping • ADEC Qualified Environmental Professional
Brice Project Chemist	Victoria Pennick	Coordinating with the analytical laboratory, reviewing analytical data, and ensuring that the data quality objectives (DQOs) are achieved.	Victoria Pennick has over 30+ years of technical and professional experience as an environmental chemist, both in the laboratory and the field. She holds a BS in Biological Sciences from the University of California – San Diego.	• 40-Hour HAZWOPER • 8-hour refresher per 29 CFR 1910.120(e) • ADEC Qualified Environmental Professional • Hazardous material shipping (IATA and DOT)

Table 4-1 Personnel Qualifications

Title	Name	Responsibilities	Education/ Experience	Specialized Training/Certifications
Field Manager/ Site Safety and Health Officer	Monte Garroutte	Implementing, overseeing, and coordinating safety aspects and objectives of this project. Managing the sampling elements.	Monte Garroutte has 5 years of experience working as a regulator and 4 years working as a consultant on contaminated sites characterization and remediation projects in Alaska. He holds a BS and MS in Biological Sciences from University of Alaska, Fairbanks.	• ADEC Qualified Environmental Professional • 40-hour HAZWOPER • 8-hour refresher per 29 CFR 1910.120(e) • EPA Region 10 RCRA and TSCA Training • NEG-350 Collaborative Negotiations and Conflict Management for Environmental Professionals • EPA Superfund 101 – Fundamentals of Superfund • EPA Environmental Response Training Program: Sampling for Hazardous Materials • First-aid certification • Adult CPR/AED certification
Program Health and Safety Manager	Jamey Smith	Developing, implementing, and overseeing all safety and health-related aspects of the project.	Jamey Smith has 20 years of experience managing Health, Safety, and Environmental functions on construction and mining projects. He holds an MS Leadership and Management and BA Occupational Safety and Health.	• 40-hour and 8-Hour HAZWOPER Instructor • OSHA 10- and 30-Hour Construction and General Industry Trainer • OSHA 4200 Maritime Trainer • Certified Safety Professional (30542) • Certified Mine Safety Professional (989) • MSHA approved instructor (IS, IU, MR)

Notes:
For definitions, refer to the Acronyms and Abbreviations section

WORKSHEET 6 – COMMUNICATION PATHWAYS

Table 6-1 describes the communication pathways and modes of communication that will be used during the project after the Work Plan/UFP-QAPP has been approved. The communication pathways presented below define the procedures for soliciting and/or obtaining approval between project personnel, contractors, and laboratory staff. These procedures should be followed when an approved project activity requires real-time modifications to achieve project goals, or a Work Plan/UFP-QAPP amendment must be obtained. Procedures for stopping work and responsible entities are also identified.

Table 6-1 Communication Pathways

Communication Drivers	Responsible Entity	Name	Telephone Number	Procedure
Point of contact with the ADEC during project execution	AKARNG Project Manager	Jenna Van Horn	(907) 428-7696	Technical, QA, and decision-making matters concerning project execution (verbal, written, or electronic).
Amendments to the UFP-QAPP	USACE COR	Mike Utley	(907) 753-2691	Coordination of the UFP-QAPP amendment dialog. Amendments to the UFP-QAPP prior to initiation of fieldwork will require a Work Plan/UFP-QAPP Addendum which will be provided to USACE, AKARNG, and ADEC for concurrence prior to making any changes.
Contracting issues requiring coordination between the USACE Project Manager and Brice	USACE Project Manager	Heidi Long	(907) 244-0618	The USACE will maintain oversight for the overall project action.
Technical review and oversight of RA scope, activities, and process				

Table 6-1 Communication Pathways

Communication Drivers	Responsible Entity	Name	Telephone Number	Procedure
Tracking progress in the field	USACE COR USACE Project Manager	Mike Utley Heidi Long	(907) 753-2691 (907) 244-0618	Field progress updates will be provided to the USACE, AKARNG, and ADEC Project Manager daily via email (by COB the following day). Updates on progress will be emailed to ADEC directly from the AKARNG Project Manager.
Planning and preparatory communication and meetings	Brice Project Manager	Monica Oakley	(907) 275-2914	Facilitates review meetings, status meetings, and other meetings with the client and stakeholders, as necessary.
Change in field conditions				Coordinates with the USACE to adjust approach, if necessary. Contact will be initiated by the end of the next business day.
Changes to fieldwork	Brice Field Manager	Monte Garroutte	(907) 750-8688	Notifies Brice Project Manager of fieldwork issue and provides draft Field Change Request forms by close of business the next business day.
	Brice Project Manager	Monica Oakley	(907) 275-2914	Notifies the USACE Project Manager and COR and provides Field Change Request forms by the end of the next business day.
	USACE Project Manager	Heidi Long	(907) 244-0618	Evaluates the situation based on information from the Brice Project Manager and selects the recommended solution or an alternate solution. If a significant change to fieldwork will occur based on a recommended solution, the ADEC will be notified prior to implementing the change.
Analytical data results and data quality issues	Brice Project Chemist	Victoria Pennick	(907) 205-9892	Identifies any data quality issues and works with the laboratory Project Manager to resolve issues. Notifies Brice Project Manager of the issue and resolution. If there is a significant data quality issue, the Project Chemist may immediately notify the Brice Project Manager and the Field Team.

Table 6-1 Communication Pathways

Communication Drivers	Responsible Entity	Name	Telephone Number	Procedure
	SGS Project Manager	Justin Nelson	(907) 550-3205	Identifies data quality issues and provides solutions for the Project Chemist to resolve the issue.
	Brice Project Manager	Monica Oakley	(907) 275-2914	Notifies the USACE Project Manager of data quality issues and initiates a resolution within one week.
	USACE Project Chemist	Mike Utley	(907) 753-2691	Evaluates whether actions to resolve data quality issues are adequate, with input from the USACE Project Manager and Brice Project Manager, if necessary.
Accident or unplanned health and safety incident	Brice SSHO	Monte Garroutte	(907) 750-8688	Notifies the Brice Project Manager within one hour.
	Brice Project Manager	Monica Oakley	(907) 275-2914	Notifies the USACE by phone within 24 hours.
Stop work/initiate corrective action	Brice SSHO	Monte Garroutte	(907) 750-8688	Stops work and notifies the Brice Project Manager within one hour.
	Brice Project Manager	Monica Oakley	(907) 275-2914	Stops work and notifies the USACE Project Manager by the end of the next business day. Recommends corrective action.
	USACE Project Manager	Heidi Long	(907) 244-0618	Notifies the Contracting Officer and ADEC by the end of the next business day with recommendations for corrective action.
	Monitoring Archaeologist	Tom Wolforth	(907) 428-7184 (Office) (907) 444-5622 (Field Cell)	Notifies AKARNG Project Manager immediately upon encountering potential or actual cultural remains or burials. AKARNG Project Manager notifies USACE Project Manager.

Notes:
For definitions, refer to Acronyms and Abbreviations section.

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WORKSHEET 9 – PROJECT SCOPING SESSION PARTICIPANTS SHEET

This worksheet documents a scoping session held for the project and identifies team members who are responsible for planning the project.

Project Name: National Guard Federal Scout Armory Remedial Action
Site Location: Savoonga, Alaska
Date of Planning Session: 4 October 2018 and 5 December 2018
Brice PM: Monica Oakley, PMP
Participants:

Name	Title/Role	Meeting Dates		Organization and Email
		4 October 2018	5 December 2018	
Guy Warren	Project Manager (former)	X	X	USACE guy.l.warren@usace.army.mil
Heidi Long	AKARNG Project Manager (former, now current USACE Project Manager)	X		USACE Heidi.l.long@usace.army.mil
Monica Oakley	Project Manager	X	X	Brice moakley@briceenvironmental.com
Jamie Oakley	Brice President	X	X	Brice joakley@briceenvironmental.com
Monte Garroutte	Field Scientist	X	X	Brice mgarroutte@briceenvironmental.com
Mikayla Daigle	Engineer		X	Brice mdaigle@briceenvironmental.com
Danielle Duncan	Project Manager (former)		X	ADEC danielle.duncan@alaska.gov

Notes:
For definitions, refer to the Acronyms and Abbreviations section.
* Participated via teleconference

The following activities took place during the meeting conducted on 4 October 2018:

- Provided an overview of project objectives and the schedule for the scoping meeting, planning documents, fieldwork, and reporting.
- Discussed use of the term “groundwater” versus “supra-permafrost water”. USACE recommended that a stakeholder meeting be conducted before document submittal to discuss issues surrounding supra-permafrost water. The meeting should discuss Arctic Zone cleanup levels and the Technical Memorandum, *Establishing Arctic Zone Cleanup Levels* (ADEC 2017a). The stakeholder meeting was scheduled for 5 December 2018.
- Discussed communication pathways.
- AKARNG will provide notifications to all villages prior to fieldwork. Brice will provide a notification flier with the AKARNG logo for AKARNG to send to the villages.

The following activities took place during the meeting conducted on 5 December 2018:

- Discussed preliminary technical approach for each of the three sites, including the Arctic Zone Cleanup Levels Technical Memorandum and how it may/may not apply to Savoonga.
- ADEC clarified that sites located south of latitude 68 degrees (°) North will be difficult for ADEC to approve Arctic Zone cleanup levels.
- USACE mentioned that not applying Arctic Zone cleanup levels will likely require that AKARNG perform long-term monitoring (LTM); however, LTM results at remote sites underlain by continuous permafrost is likely to be variable depending on seasonal melt and LTM sampling incurs significant costs.
- ADEC suggested that the project team provide a multitude of data (borings, profiles, etc.) to support the conclusion that the sites are underlain by continuous permafrost. In addition, the project team should consider excavating contaminated soil, as leaving the source in place slows cleanup efforts.
- ADEC mentioned that if the field team conducted multiple investigations over the course of a few years and were not able to collect water samples from LTM wells, this would strengthen the argument for an Arctic Zone determination at the respective site.
- Regarding the Savoonga Federal Scout Armory (FSA), the group discussed the 2017 Site Characterization Report and only the southeast portion of the site has not been delineated. The feasibility of arguing that the supra-permafrost at the Savoonga FSA is impacted by salt water was discussed. This site is only 200 feet from the ocean; however, it may be too far above the ocean level to be impacted and considered surface water.
- Action items following this meeting were that Brice would begin drafting the Pre-Draft Decision Documents for Gambell and Savoonga. The draft Gambell Decision Document would be submitted first to ADEC for review. Following receipt of comments, the draft Savoonga Decision Document would be submitted to ADEC and would incorporate the edits (as applicable) that were requested on the Gambell Decision Document. Then concurrently, the draft-final versions of both Decision Documents would be submitted by ADEC to management and legal at ADEC.

WORKSHEET 10 – CONCEPTUAL SITE MODEL

This worksheet includes the background of the site contaminants; site history; describes the climate and environmental setting; describes previous treatability studies; and presents a human health conceptual site model (CSM).

Site Background and Description

The village of Savoonga lies on the north-central tip of St. Lawrence Island in the Bering Sea, approximately 164 miles west of Nome, Alaska (Figure 1). The Savoonga FSA is an active contaminated site in the ADEC Contaminated Sites Program database, with File Number 670.38.002, Hazard ID 3099, and the site name "AKARNG Savoonga FSA" (Figure 2)

According to the 2010 Census, Savoonga, Alaska has a population of 671. The only other community on St. Lawrence Island is Gambell (population 681), located approximately 39 miles west of Savoonga. Beyond local access, Savoonga is only accessible by air.

Historically, local natives have relied on a subsistence lifestyle consisting of fish, wildlife, and plants from the region. In addition, many migratory birds pass through the area on a seasonal basis.

Climate

Savoonga has a subarctic maritime climate with some continental influences during winter. Summer temperatures average 40 degrees Fahrenheit (°F) to 51°F. Winter temperatures average -7°F to 11°F. Average annual precipitation is 10 inches, with 58 inches of snowfall (Western Regional Climate Center, 2012). St. Lawrence Island is subject to prevailing winds averaging 18 miles per hour. Typically, the Bering Sea freezes around St. Lawrence Island in mid-November, with breakup of sea ice occurring in late May. (Alaska Department of Commerce, Community, and Economic Development, Division of Community and Regional Affairs 2012).

Geology

The dominant soil lithology is a clayey silt containing boulders of bedrock material with most areas featuring a 1-foot layer of peat and organic material above the soil (Ogden 1998). During a 1998 RI, soil was assessed for physical properties including grain size analysis. It was determined that the material in the active layer is a slightly clayey, silty, gravelly sand with a hydraulic conductivity of approximately $2x10^{-3}$ centimeters per second (ERM West, Hart Crowser 1999). The bedrock is Quaternary-age basalt resulting from a large shield volcano that extends over most of the central part of the island (Waller 1959; Patton et al. 2011). Well logs from 1966 and 1972 document igneous rock at depths of 11 feet below ground surface (bgs) and 17 feet bgs, respectively (Alaska Department of Natural Resources [ADNR] 1966, 1972). Permafrost is continuous in the subsurface below Savoonga and lies anywhere between 0.5 feet bgs to 4 feet bgs (Ogden 1998; ERM West, Hart Crowser 1999; North Wind, Inc. 2009; Clarus 2006; CH2M HILL 2013; Eagle Eye 2017).

Hydrogeology

Permafrost is present at the site at depths of 2 to 4 feet bgs. An active, seasonally thawed groundwater layer is present above the permafrost layer but is not encountered at all times of the year (Ogden 1998).

Water for the village is currently obtained from a 195-foot-deep well drilled in 1972 located a half-mile southeast (upgradient) of the FSA (Figure 2). Water is pumped from the well to a 100,000-gallon storage tank within the village (Clarus 2006). The well house for the village water supply is on the northeast end of the air strip (Ogden 1998). The well was installed through a known thaw bulb associated with Sivuungaq River (Figure 3). The closest extent of the thaw bulb is approximately 1,500 feet from the FSA facility (ERM West, Hart Crowser 1999).

Site History

The Savoonga FSA Property lies adjacent to the main beach access road on the northwestern side of the city, approximately 200 feet south of the Bering Sea. The beach access road acts as the southeastern boundary of the FSA property. The FSA complex is situated on a gravel pad. Infrastructure includes the following:

- A 20-foot by 60- foot, wood-framed building constructed in 1960 (the old FSA building)
- A 30-foot by 40-foot wood-framed building constructed in 1985 (the new FSA building)
- An elevated walkway connecting the old and new FSA buildings
- A 1,500-gallon aboveground storage tank (AST) near the new FSA
- Two 1,500-gallon ASTs near the old FSA

The Savoonga FSA is a known petroleum-contaminated soil source area, resulting primarily from an estimated 500-gallon heating oil spill to the ground surface from a 3,000-gallon AST. In 1985, 200 gallons of Jet A fuel leaked from drums stored near the AST. In 1992, a leak of an unknown quantity of heating oil from a fuel line.

In 1993, two 1,500-gallon ASTs replaced one 3,000-gallon AST near the old FSA building. In 1994, the FSA was deactivated. In 2002, the 3,000-gallon AST near the new FSA was removed and was replaced by the 1,500-gallon AST near the new FSA (Eagle Eye 2017). All three 1,500-gallon ASTs are currently active. Several investigations have been completed at the Savoonga FSA to determine the nature and extent of contamination (Figure 4). The following subsections present a summary of the investigations at the site.

1996 Preliminary Assessment/Site Investigation

In 1996, a Preliminary Assessment/Site Investigation included sampling in potentially contaminated areas (Ogden 1998). Seven locations were chosen for field screening around areas of suspected or potential contamination; soil was collected from 0.5 feet bgs and screened using an infrared spectrophotometry field screening tool for total petroleum hydrocarbons (TPH). Results of field screening guided selection of analytical sampling locations. Five locations were selected for analytical sampling just outside of areas where field screening indicated contamination. The locations are displayed on Figure 4 and are labeled as "SV" with three digits (e.g., SV021).

Analytical soil samples were collected from 0.5 feet bgs and analyzed for diesel range organics (DRO) and TPH. A DRO concentration of 160 milligrams per kilogram (mg/kg) was detected near the shed between the old and new FSA buildings at SV051 (Figure 4). The four remaining samples, collected from the perimeter around the site, showed a maximum concentration of DRO at 23 mg/kg and all results for TPH were non-detect (ND). No Further Action was recommended for the site because contaminant concentrations were below the ADEC cleanup criteria applicable at the time.

1998 Remedial Investigation

In September 1998, to further characterize the site, a remedial investigation (RI) was conducted for the AKARNG (ERM West, Hart Crowser 1999). A total of 19 boreholes were hand-augered within the extent of the gravel pad and one location was advanced west of the gravel pad in the marshy area. An objective of the hand-auger boreholes was to determine the extent and depth of permafrost. Within the gravel pad, the advancement of boring holes was limited due to frozen soil and extended to a maximum depth of 2 to 2.5 feet. The borehole advanced west of the gravel pad encountered permafrost at 3.5 feet bgs.

From the 20 locations, 42 soil samples were analyzed for DRO and a select few were analyzed for gasoline range organics (GRO); residual range organics (RRO); benzene, toluene, ethylbenzene, and xylenes (BTEX); and polycyclic aromatic hydrocarbons (PAHs). Soil samples were collected from the surface, below the organic layer, at a depth of approximately 0.5 feet bgs and at the bottom of the borehole. Additionally, the one active, seasonal water sample was to be collected near the northernmost 1,500-gallon AST; however, refusal was met at 2.5 feet bgs and recovery was insufficient. Soil samples from the 1998 RI are presented on Figure 4 and are labeled as "B-" with two digits (e.g., B-01).

Analytical soil sample results indicated contamination was present at the south corner of the old FSA building near the ASTs and downgradient (north and west) of the 3,000-gallon AST by the new FSA building. Near the southern corner of the old FSA, DRO concentrations greater than 1,000 mg/kg were present in two borings with a concentration of 1,100 mg/kg in surface soil and 11,000 mg/kg in subsurface soil in borehole B-12; and a concentration of 17,000 mg/kg in surface soil and 8,900 mg/kg in subsurface soil in boreholeB-13. These samples were also submitted for PAH analysis; no PAH compounds were detected at concentrations greater than the Arctic Zone risk-based cleanup levels applicable at the time of the investigation. These two locations were bounded by samples with concentrations of DRO less than 1,000 mg/kg (B-10, B-14, and B-17). Adjacent to the AST on the north side of the new FSA building, DRO concentrations of 1,300 mg/kg and 1,500 mg/kg were detected in the subsurface in boreholes B-05 and B-06, respectively. Downgradient along the edge of the gravel pad at borehole B-18, DRO concentrations were less than 30 mg/kg in subsurface soil.

The RI Report recommended that DRO be considered the primary contaminant of concern (COC) at this site (ERM West, Hart Crowser 1999). The highest concentration of RRO was 380 mg/kg, GRO was 27 mg/kg, total BTEX was 0.35 mg/kg, and benzene was non-detect.

Due to the presence of continuous permafrost, the contractor recommended that the site satisfied the Arctic Zone criteria, specifically citing the following:

- Via personal communication, the opinion of Mr. Pierre Costello of the U.S. Public Health Service, a design engineer responsible for the sewer and water upgrades completed in Savoonga around 1998 (ERM West, Hart Crowser 1999).
- A subsurface investigation conducted by Clarke Engineering in 1994 related to utility upgrades. This investigation completed 11 borings across Savoonga, including two near the FSA indicating permafrost was between 1 and 3 feet bgs.
- A groundwater investigation by Terrasat in 1996.
- The RI background boring located approximately 15 feet south of the new armory building.

One soil sample collected during the RI exceeded the current Arctic Zone cleanup level for DRO of 12,500 mg/kg, and it was estimated that 10 to 20 cubic yards (cy) of soil contained DRO concentrations greater than 12,500 mg/kg.

2004 Alternate Cleanup Level Demonstration Project

In August 2004, on behalf of AKARNG, an investigation was completed to demonstrate the validity of a proposed alternative cleanup level (ACL) (Clarus 2006). The investigation included soil and porewater sampling. Twelve hand-augered soil borings were advanced to refusal at a depth of 4.5 feet bgs, and two drive-point well points with 2-foot screens were installed to approximate depths of 4.5 feet bgs. The soil and porewater sample locations are displayed on Figure 4 and are labeled by "SAV-ACL-" followed by three digits (e.g., SAV-ACL-006).

Seven soil samples were collected from locations upgradient from the source area. All soil samples were analyzed for DRO, and five samples collected from locations closest to the source area were also analyzed for GRO, BTEX, and Synthetic Precipitation Leaching Procedure-DRO. Two porewater samples were collected from well points near the former shed and near the old FSA ramp were analyzed for DRO and GRO. Porewater collected from the well point near the former shed (SAV-ACL-016) exhibited a petroleum odor and a slight sheen.

Analytical soil sample results for DRO ranged from 33.4 mg/kg to 233 mg/kg, is below the current ADEC Method Two Arctic Migration to Groundwater soil cleanup level. The porewater samples indicated elevated DRO concentrations in SAV-ACL-015 and -016 of with results of 30.2 milligrams per liter (mg/L) and 4.07 mg/L, respectively. Additionally, concentrations of GRO and BTEX were detected in sample SAV-ACL-015. However, the porewater samples contained significant amounts of suspended solids, which may have biased the contaminant concentrations high. No free product was noted during collection of the samples.

As part of the ACL Demonstration Project, it was proposed that supra-permafrost porewater was not a reasonable source of drinking water due to the limited quantity and presence of continuous permafrost. Additionally, it was recommended that porewater cleanup levels for the Savoonga FSA should be 10 times the ADEC Table C groundwater cleanup levels; however, based on this recommendation the DRO concentration in porewater at SAV-ACL-015 still exceeded the proposed ACL.

The contractor recommended the following ACLs for soil:

- GRO was the maximum concentration allowed in 18 AAC 75.341; 1,400 mg/kg
- DRO was a Method Three calculated value based on the ingestion pathway: 10,000 mg/kg
- total xylenes were based on Method Three calculations for inhalation: 844 mg/kg and
- benzene, toluene, and ethylbenzene were based on Method Three calculations, Migration to Groundwater pathway, and the 10 times rule. ACLs for benzene, toluene and ethylbenzene were proposed as 0.655 mg/kg, 361 mg/kg, and 490 mg/kg respectively.

2009 Secondary Site Characterization

In June 2009, a site characterization was conducted to both delineate the extent and determine the volume of DRO-contaminated soil above the ADEC Method Two Migration to Groundwater cleanup level (250 mg/kg; North Wind, Inc. 2009). A total of 48 borings were advanced using a gas-powered auger between two 5-foot grid patterns. Twenty-two (22) borings in Grid 1 were advanced to 0.5 to 1.5 feet bgs to the west of the new FSA buildings, and 26 borings in Grid 2 were advanced to 0.7 to 2.0 feet bgs on the east and south ends of the old FSA. Frozen soil was encountered in every Grid 1 boring between 0.4 and 1.5 feet bgs. Frozen soil was encountered in Grid 2 borings in 10 of the 26 borings between 0.7 and 1.5 feet bgs. The remaining Grid 2 borings encountered refusal at 2.0 feet bgs.

During the field effort, 90 soil samples were field screened using a photoionization detector (PID) and 22 primary soil samples were collected based on the highest field screening results and submitted to the laboratory for DRO analysis. The analytical results showed DRO concentrations greater than 250 mg/kg in soil on the west side of the new FSA (Grid 1) and less than 250 mg/kg on the southern side of the old FSA (Grid 2). There was limited correlation between field screening and analytical results. The report conclusions included an estimated 11 cubic yards of soil with DRO concentrations greater than 250 mg/kg were present at the site. The 2009 locations are presented on Figure 4 and are labeled "09SAV" followed by six digits (e.g., 09SAV-01-G100).

2011 Data Gap Investigation

In July 2011, a data gap investigation (DGI) was conducted to delineate the extent of petroleum-contaminated soil and porewater and to support previous remediation recommendations. During the investigation, no new sources of contamination were identified, and no evidence of stained soil or recent spills was observed (CH2MHill 2013).

A total of 21 soil samples were collected from 12 locations at depths between 0 and 3 feet bgs. Initially, samples were to be collected at greater depths; however, permafrost or ground conditions prevented deeper advancement. Four porewater samples were collected from well points on the north and northwest side of the gravel pad. The 2011 locations are presented on Figure 4 and are labeled "11SAVSB" followed by three digits (e.g., 11SAVSB013) and for well points as "11SAVGW" with three digits (e.g., 11SAVGW001); 11SAVSB004 and 11SAVSB007 were soil and porewater sample points.

The soil samples were field screened with a PID prior to collection. Samples were collected from the locations with the highest field screening results and submitted to the laboratory for DRO analysis, with a subset analyzed for BTEXs, PAH, extractable petroleum hydrocarbons (EPH), and volatile petroleum hydrocarbons (VPH). Porewater samples were submitted for DRO analysis, and one sample was also analyzed for BTEX, PAHs, EPH, and VPH.

Analytical soil results confirmed petroleum-related contamination in the previously identified areas. Several analytes exceeding the ADEC Method Two Migration to Groundwater cleanup levels were observed, with maximum concentrations detected at sample location 11SAVSB001. Contaminants that exceeded cleanup levels at this location were: DRO (17,000 mg/kg), benzene (3.1 mg/kg), toluene (160 mg/kg), ethylbenzene (48 mg/kg), total xylenes (250 mg/kg), naphthalene (180 mg/kg), 1-methylnaphthalene (230 mg/kg), and 2-methylnaphthalene (360 mg/kg).

The analytical porewater results showed an elevated DRO concentration of 18 mg/L at location 11SAVSB004. The three remaining porewater samples had detected DRO concentrations of 0.6 mg/L, 0.81 mg/L and 1.1 mg/L, which were below the current ADEC Table C groundwater cleanup level of 1.5 mg/L.

In a 2017 letter from ADEC, the ACLs that were proposed for DRO and benzene in the 2011 DGI Report (CH2M HILL 2013) were not approved, and it was recommended that the ADEC Method Three ACL calculator be used to calculate soil ACLs.

2016 Site Characterization Investigation

In 2016, a Site Characterization Investigation was conducted (Eagle Eye 2017) to fill data gaps and evaluate the nature and extent of groundwater contamination at the Savoonga FSA. During the investigation, five monitoring wells were installed around the perimeter of the facility (Figure 4, MW-01 through MW-05).

The monitoring wells were installed surrounding the FSA site to maximum depths of 6.5 feet bgs. Permafrost was encountered at 2 to 4 feet bgs and ice was found in each boring.

Two of five wells (MW-04 and MW-05) were installed on the north and northwest side of the facility, and porewater was encountered in these wells after installation between 2.5 and 6.1 feet bgs. In the three wells installed on the south and east side of the facility (MW-01, MW-02, and MW-03), porewater was observed between 3.1 and 3.6 feet bgs. Wells MW-02, MW-03, and MW-04 contained DRO, RRO, and toluene concentrations greater than the ADEC Table C groundwater cleanup levels; DRO exceeded in MW-02 and MW-03, RRO exceeded in MW-04, and toluene exceeded in MW-02 and MW-04. The maximum DRO concentration was 2.9 mg/L in MW-03. As a result of the investigation, it was suggested that the extent of porewater contamination was not defined upgradient and crossgradient, particularly on the southeast side of the old FSA building.

2020 Alternative Cleanup Levels Summary

In 2020, soil ACLs for petroleum hydrocarbons, including DRO, RRO, GRO, BTEX, and PAH were calculated using the most current ADEC Method Three cleanup levels calculator and petroleum cleanup levels calculator (Brice, 2021). Site-specific input values for fraction of organic carbon (foc) and hydraulic conductivity were used to calculate the soil ACLs. All other inputs were the ADEC default values. The foc input value was derived by calculating the 95 percent (%) lower confidence level of the mean of TOC samples collected outside of contaminant source zones during the 1998 Remedial Investigation (ERM West, Hart Crowser 1999) and the 2004 ACL Demonstration Project investigation (Clarus 2006). When using the 10 previous foc values and excluding one outlier result, the calculated site-specific foc value is 0.01278 grams carbon per gram soil.

A site-specific hydraulic conductivity value was derived from the 1998 Remedial Investigation (ERM West, Hart Crowser 1999). Results for grain size analysis performed on a soil sample collected from boring location B-13 at a depth of 1.5 to 2 feet bgs were used in the Hazen equation to calculate a site-specific hydraulic conductivity value of $2x10^{-3}$ centimeters per second. This boring was chosen to be representative of the conditions in the active layer.

AKARNG submitted the ACL Summary and approval request to ADEC on 25 June 2020. ADEC approved the ACLs in a 30 July 2020 letter. Table 10-1 presents the soil ACLs.

Table 10-1 ADEC-Approved Soil ACLs

COC	ADEC-Approved ACLs (mg/kg)[1]
GRO	1,400
DRO	3,000
RRO	10,000
Benzene	0.13
Toluene	47
Ethylbenzene	1.2
Total Xylenes	13
Chrysene	1,200

Table 10-1 ADEC-Approved Soil ACLs

COC	ADEC-Approved ACLs (mg/kg)[1]
Fluorene	460
Naphthalene	0.43
Pyrene	1,100
1-Methylnaphthalene	4.9
2-Methylnaphthalene	15

Notes:
For definitions, refer to the Acronyms and Abbreviations section.
[1] Approved by ADEC on 30 July 2020

Human Health Conceptual Site Model

This section describes the contaminants of potential concern (COPCs), COCs, contamination sources and release mechanisms, potentially impacted media, potential contaminant transport mechanisms, and exposure routes and pathways. COPCs for the Savoonga FSA site were determined using site history and known or potential sources of contamination. COCs were determined by comparing results for analytes detected during past investigations against the ADEC approved ACLs (Brice 2021), identified as the Project Action Limits (PALs) on Worksheet 15, Table 15-1 for soil, and Table 15-2 for groundwater. The CSM will be updated based on the RA results and documented in the subsequent RA Report.

A CSM is a tool used to describe and evaluate how human receptors might contact site chemicals under current and likely future conditions. The preliminary CSM uses data gathered from previous investigations to assess the potential receptors and exposure pathways at the Savoonga FSA. The CSM was prepared in accordance with the ADEC *Guidance on Developing Conceptual Site Models* (ADEC 2017b). The preliminary human health graphic and scoping forms are provided in Appendix D.

The CSM includes identification of the following elements:

- Sources and chemical type
- Affected media
- Chemical release and transport mechanisms
- Human receptors
- Pathways and exposure routes

Sources and Type of Chemicals

The potential contaminant sources at the Savoonga FSA are associated with leaks and spills from ASTs and discarded drums. COPCs under these conditions are petroleum, oil, and lubricants including DRO, BTEX, and PAHs. Previous investigations have confirmed the presence of detectable concentrations of DRO, RRO, BTEX, and PAHs in soil and supra-permafrost porewater. DRO, BTEX, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene have been identified as COCs for soil; DRO, RRO, and BTEX have been identified as COCs for supra-permafrost porewater.

Affected Media

Affected media includes surface soil, subsurface soil, and supra-permafrost porewater. Potentially affected media includes surface water, indoor air, and outdoor air. Supra-permafrost porewater at the FSA property has been encountered at depths as shallow as 2.5 feet bgs; in the absence of a determination in accordance with 18 AAC 75.350, supra-permafrost porewater could be considered a potential future source of drinking water in Savoonga.

Chemical Release and Transport Mechanisms

Compounds released to the environment may undergo physical and chemical processes that can alter their chemical makeup or properties. The fate of metals is influenced by pH, oxygen content, salinity, and the presence of other metals. Interactions can result in both beneficial or adverse effects on ecological receptors and antagonistic or additive effects when it is present with other elements (Agency for Toxic Substances and Disease Registry [ATSDR] 2005, 2007). Petroleum products released to the environment migrate through soil as bulk oil flow infiltrating the soil and/or as individual compounds separating from the bulk petroleum mixture and dissolving in air or water (ATSDR 1999). DRO and PAHs are more likely to biodegrade and adsorb to soil or sediment than inorganic chemicals. The primary fate and transport processes that are of concern for chemicals are: adsorption to soil/sediment, leachability/water solubility, surface runoff/groundwater migration, and bioconcentration/ bioaccumulation potential.

Adsorption and/or Leaching. DRO and PAHs are COPCs. These compounds adsorb to soil or sediment and may leach to supra-permafrost porewater.

Surface Runoff/Groundwater Migration. Porewater is perched on top of permafrost, making porewater migration/runoff a potential transport mechanism. Surface water is also present; therefore, surface water migration/runoff may also be a potential transport mechanism.

Partitioning to Air. Volatile compounds, including BTEX, have been detected in soil and supra-permafrost porewater; therefore, volatilization of these compounds may be a potential transport mechanism.

Bioconcentration/Bioaccumulation. Contaminants have the potential to bioaccumulate; however, plants do not significantly take up fuel hydrocarbons and this is not considered to be a potential transport mechanism.

Human Receptors

Access to the Savoonga FSA property is not restricted. The site is located within the Village of Savoonga, and the property boundaries abut to residential lots (toward the east, west, and north), and a road (toward the south). Current receptors include residents, construction workers, site visitors, trespassers, and subsistence harvesters and consumers.

Exposure Pathways

An exposure pathway describes how contaminants move through the environment from a source to a point of contact with a person, including the specific exposure route (e.g., through the skin, lungs, or digestive tract). Exposure pathways are considered complete if the following four elements exist:

- A source
- A mechanism of release, retention, or transport of a given chemical in a given medium
- A point of contact with the affected medium
- An exposure route at the point of contact (e.g., ingestion, dermal absorption, or inhalation)

If any of these elements is missing, the pathway is considered incomplete and thus does not present a means of exposure. The potentially complete exposure pathways to COPCs are described in the following paragraphs.

Soil

Direct releases to soil have occurred, and historical data indicates that soil has been impacted by fuel releases.

Incidental Ingestion. Current and future recreational and subsistence users may potentially ingest soil by consuming fine particles that adhere to skin surfaces, particularly on the hands. Hypothetical future construction workers are likely to be engaged in soil-moving activities; therefore, exposure to COPCs through incidental ingestion of soil is considered a potentially complete exposure pathway. Likewise, residents and commercial/industrial workers may incidentally ingest soil from outdoor exposure around their home or workplace while gardening or landscaping.

Dermal Contact. The dermal contact exposure pathway is considered a potentially complete exposure pathway for all receptors. Current and future residents, construction workers, site visitors, trespassers, and subsistence harvesters and consumers may potentially come into contact with soil; thus, the dermal pathway would be considered potentially complete. Appendix B of the ADEC Guidance on Developing Conceptual Site Models (ADEC 2017b) lists chemicals that should be considered for the dermal pathway.

Inhalation of Fugitive Dust. Inhalation of particulates by all receptors is considered a potentially complete exposure pathway. Soil disturbance could re-suspend dust that may be inhaled rendering this exposure pathway potentially complete. However, it should be noted that under current and likely future conditions, the climate and vegetation minimize this potential exposure pathway.

Inhalation of Soil Vapor. Inhalation of vapors in outdoor air by current and future receptors is considered potentially complete until further investigation is performed. Savoonga has a cold climate and most buildings are elevated off the ground surface, which reduces the potential effects of outdoor and indoor air inhalation. Appendix D of the ADEC Guidance on Developing Conceptual Site Models (ADEC 2017b) lists which chemicals are considered volatile for the purposes of this exposure pathway.

Groundwater

Historical data indicates that supra-permafrost porewater has been impacted by fuel releases. For purposes of this CSM, the supra-permafrost porewater at the Savoonga FSA is being evaluated relative to the "groundwater" exposure pathways referred to in the ADEC *Guidance on Developing Conceptual Site Models* (ADEC 2017b).

Ingestion and Dermal Contact. Supra-permafrost porewater is not currently utilized for domestic use at the Savoonga FSA. Domestic water for the Village of Savoonga is provided by a well, which extends to a depth of 195 feet, located on the south side of the village. The supra-permafrost porewater at the Savoonga FSA cannot support domestic use. For the purposes of this CSM, future receptors are not assumed to utilize porewater for domestic purposes. In the absence of a determination in accordance with 18 AAC 75.350, supra-permafrost porewater could be considered a potential future drinking water source; therefore, the ingestion of groundwater is a potentially complete exposure pathway for future receptors. Receptors could contact the supra-permafrost porewater during construction activities; therefore, dermal contact with supra-permafrost porewater is considered a potentially complete exposure pathway.

Inhalation of Groundwater Vapor. Currently, this is not a complete exposure pathway; however, future receptors could potentially be exposed to volatile COPCs in indoor air from the supra-permafrost porewater if residences or buildings are constructed on or near the FSA property that do not use elevated building techniques. Supra-permafrost porewater could be considered a potential future drinking water source; therefore, there is a complete current or future inhalation of tap water vapor pathway. Future construction workers could potentially be exposed to COPCs through excavation activities.

Sediment and Surface Water

Impacted soil, surface water, and supra-permafrost porewater on the FSA property could potentially migrate/runoff to offsite surface water and sediment.

Incidental Ingestion and Dermal Contact. Current and future receptors could be exposed to chemicals in sediment or surface water via incidental ingestion or dermal contact with both surface water and sediment during recreation activities or subsistence harvesting.

Inhalation of Vapor. Savoonga is located in a cold climate; therefore, exposure to chemicals volatilizing from sediment or surface water is considered to be minimal and infrequent. However, for purposes of this CSM, this pathway is considered potentially complete until further investigation is performed.

WORKSHEET 11 – DATA QUALITY OBJECTIVES

The primary objectives of the RA include the following:

- Remove remaining soil containing concentrations of COPCs above PALs.
- Install temporary monitoring wells to characterize the eastern lateral extent supra-permafrost pore water impacted by historical petroleum releases.

Planned RA activities to achieve the project objectives include:

- Excavation and removal of up to 20 tons of impacted soil
- Confirmation soil sampling from excavation boundaries to determine presence/absence of contaminated soil with chemical concentrations greater than the PALs.
- Supra-permafrost porewater sampling from newly installed temporary monitoring wells located east of the source area to determine presence/absence of contamination in supra-permafrost porewater at concentrations greater than the ADEC Table C groundwater cleanup levels.

Who will use the data? The data will be used by the AKARNG project team, ADEC, and project stakeholders to support environmental decisions at the Savoonga FSA.

What are the project action limits? The PALs are provided in Worksheet 15. Past analytical results were compared to current ADEC Method Two cleanup criteria, and analytes exceeding these criteria have been retained as COCs for further evaluation.

What will the data be used for? Collected data will be used to evaluate additional remedial alternatives or to propose project closure.

What types of data are needed? The types of data that will be collected are summarized in Table 11-1.

How "good" do the data need to be to support the environmental decision? Analytical sample results will be compared to the PALs presented in Worksheet 15 and the measurement performance criteria (MPC) in Worksheet 12. Laboratory analytical data must be of sufficient sensitivity and quality so that results can be compared to the applicable screening and/or regulatory criteria. Data will be generated using a rigorous analytical method (such as approved U.S. Environmental Protection Agency [EPA] SW-846 reference methods). The limits of detection (LOD) for non-detections and the LOQs for detections will be less than the PALs (Worksheet 15). Sample analysis will be performed in accordance with the Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (DoD 2021b), herein referred to as the *DoD QSM*.

How much data are needed? Worksheet 18 (Sampling Locations and Methods) defines the estimated number of samples to be collected.

Where, when, and how should the data be collected/generated? Fieldwork is scheduled to occur during the summer of 2022 A proposed project schedule is included in Worksheet 14/16 (Project Schedule). The sample collection design and rationale are discussed in Worksheet 17 and data collection methods are detailed in the SOPs attached as Appendix B. Proposed sampling matrices and analyses are outlined in Worksheet 18.

Who will collect and generate the data? Brice personnel will be responsible for sample collection in accordance with the methods outlined in this Work Plan/UFP-QAPP. The samples will be submitted to SGS in Anchorage, Alaska (SGS) for analysis and analytical result generation. SGS holds current ADEC laboratory approval and DoD Environmental Laboratory Accreditation Program (ELAP) accreditation in the planned fields of testing.

How will the data be reported and archived? All chemical data generated will be supplied to USACE per the chemical data requirements specified in Section 3 of the MED (USACE 2017) and supported by a sample summary sheet (Worksheet 26/27). Analytical results will be compared to the PALs established in Worksheet 15 and reported in accordance with the procedures outlined in Worksheet 36 (Data Validation Procedures). Laboratory analytical reports will be provided for each sample delivery group as bookmarked and searchable Level IV PDF and Staged Electronic Data Deliverable (SEDD) format (Version 5.2 Stage 2a, compliant with the POA instructional set) in accordance with the MED (USACE 2017). Survey data (Worksheet 17) and site photographs will also be included. Data, such as database management system, project geographic information system (GIS), and project reports will be archived on CD-ROM or DVD+R media and stored in the project file. Data will be summarized and included in the RA Report.

Table 11-1 Data Quality Objectives

Step 1: State the Problem	Step 2: Identify the Goals of the Study	Step 3: Identify Information Inputs	Step 4: Define Boundaries of the Study	Step 5: Develop the Analytical Approach	Step 6: Specify Performance or Acceptance Criteria	Step 7: Develop Plan for Obtaining Data
DQO 001 – SOIL CONTAMINATION REMOVAL						
There is an area of concern at the Savoonga FSA where environmental contamination exists.	Excavate contaminated soil and determine if the boundaries and concentrations of contamination have been removed to less than the PALs. Update the conceptual site model.	• Existing historical records on site use and releases • Site reconnaissance records • Existing analytical data that conforms to current practices and analytical quality standards • Analytical data from the proposed 2022 Remedial Action • Field observations and measurements from the proposed 2022 Remedial Action and historical sampling • Sample locations and depths • PALs for soil as described on Worksheet 15, Table 15-1 • Utility locations or remote sensing information • Site geologic information • Depth to water measurements • Savoonga FSA property boundaries	Temporal Boundaries: Analytical and screening data collected after release will be considered, with more recent sampling providing better representation of current conditions. Spatial Boundaries: Data collected or provided from excavation boundaries, as defined in previous investigations and observations made during the proposed 2022 Remedial Action will be considered. The proposed 2022 Remedial Action will be limited to the FSA property boundaries. Chemical Boundary: Soil analytical samples for petroleum-related compounds will be considered, with detection limits appropriate for the screening levels identified in Worksheet 15.	**Decision 1A: Lateral Extent in Soil** • If there are confirmation soil samples on excavation sidewalls bounding the area of concern and concentrations of all analytes are below PALs identified in Worksheet 15, and sample result data quality is sufficient for evaluation, then the lateral extent of contamination has been defined and removed (**Result 1A1**). • Otherwise, additional soil must be removed (**Result 1A2**). **Decision 1B: Vertical Extent in Soil** • If there are confirmation soil samples collected at the base of the excavation, and concentrations of all analytes are less than the PALs identified in Worksheet 15, and sample result data quality is sufficient for evaluation, then the vertical extent of contamination has been defined and removed (**Result 1B1**). • Otherwise, additional soil must be removed (**Result 1B2**).	Analytical data will meet quality expectations for PARCCS as defined by this Work Plan/QAPP, and in accordance with the DoD QSM.	Up to 20 cy of known contaminated soil will be excavated to ensure that soil contamination extents with concentrations above the PALs identified in Worksheet 15 are removed to the extent possible within the Savoonga FSA property boundaries.
DQO 002 – NATURE AND EXTENT OF POREWATER CONTAMINATION						
Porewater sample results at the Savoonga FSA indicate that supra-permafrost porewater has been impacted by environmental contamination.	Determine whether contamination from past releases persists in porewater at the site.	• Existing analytical data that conforms to current practices and analytical quality • Sample locations and depths • Monitoring well construction information • PALs for groundwater as described on Worksheet 15, Table 15-2 • Site hydrogeologic and geologic information • Groundwater use information • Depth to permafrost • Transport properties of detected contaminants • Depth to water measurements • Porewater flow direction and seasonality • Extent of soil contamination exceeding migration to groundwater cleanup levels • Locations of nearby surface water bodies, water wells, and drinking water aquifers • Potential alternative points of compliance • Utility locations • Field observations and measurements	Temporal Boundaries: Analytical and screening data collected after release will be considered, with more recent sampling providing better representation of current conditions. Spatial Boundaries: Data collected or provided from within the vicinity of the source areas, as defined in previous investigations, and at depths appropriate for the LNAPL release. Chemical Boundary: Porewater analytical samples for petroleum-related compounds will be considered, with detection limits appropriate for the PALs for groundwater identified in Worksheet 15.	**Decision 2A: Extent in Porewater** • If there are porewater samples collected from points downstream of the source area or release location, and samples are collected from a depth appropriate for the contaminant properties and release type, and concentrations of all analytes are below groundwater PALs (as identified on Worksheet 15), and sample result data quality is sufficient for evaluation, then the extent of contamination has been defined (**Result 1A1**) • Otherwise, samples from additional depths or locations must be collected (or evaluated from an adjacent investigation) to define lateral extent (**Result 2A2**).	Analytical data will meet quality expectations for PARCCS as defined by this work plan, and in accordance with the DoD QSM.	**2A1.** Four temporary monitoring wells will be installed to characterize the eastern extents of groundwater contamination. Monitoring well locations will be selected based on prior evidence of contamination and estimated supra-permafrost porewater flow direction. Observations and measurements of site conditions will be prepared in reporting. **2A2.** Collect additional samples, install additional wells as needed, or evaluate samples from an adjacent investigation.

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

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WORKSHEET 12 – MEASUREMENT PERFORMANCE CRITERIA

Tables 12-1 through 12-3 summarize the measurement performance criteria (MPC) for each matrix and analytical group. The tables identify the data quality indicators (DQIs), MPCs, and QC sampling and/or activity that will be used to assess the measurement performance for both the sampling and analytical measurement systems. In general, the MPCs follow those defined in the most current version of the DoD QSM and the analytical methods.

Data Quality Indicators

The quality of the data collected for this project will be verified through appropriate MPC established for both sampling procedures and analytical methods. The criteria also relate to DQIs consisting of precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) parameters. The quality of the sampling procedures and laboratory results will be evaluated for compliance with project DQOs through a review of overall PARCCS, in accordance with procedures described in Worksheet 36.

DQIs are defined in the following subsections.

Precision

Precision will be evaluated by comparing the following:

Laboratory control sample (LCS) and LCS duplicate (LCSD) (if prepared and analyzed) to determine the precision of the laboratory procedures and verify matrix interference,

- Matrix spike (MS) and MS duplicate (MSD) samples to determine the effect of the sample matrix on the precision of the results generated using the selected analytical method, and
- Primary and field duplicate (FD) sample results.

The required level of precision for FDs is relative percent difference (RPD) of 50% for soil and 30% for water. FD precision is evaluated by calculating RPD using the following formula:

$$RPD = \frac{2[(D_1 - D_2)]}{D_1 + D_2} x\,100$$

Where: D1 = first sample value

D2 = second sample value (replicate)

RPD = relative percent difference

Accuracy

Accuracy will be evaluated by reviewing the following:

- Calibrations – initial and continuing, acceptance, and frequency (deviations are assumed to be noted in case narratives)
- Surrogates – recovery and frequency
- LCS and LCSD recoveries
- MS and MSD recoveries
- Method blanks (MBs) (detections in the MB may indicate potential high bias in associated samples)
- Relative response factors (RFs) and RSD (appropriate calibration procedures improve accuracy of measurement results; deviations are assumed to be noted in case narratives)
- Gas chromatography (GC) second-column confirmation (if required)
- Tuning criteria GC/mass spectroscopy (GC/MS) – acceptability and frequency (to ensure accuracy of mass and ion abundance measurements; deviations are assumed to be noted in laboratory case narratives)
- Internal standards (ISs) (GC and GC/MS) – acceptability and frequency (deviations are assumed to be noted in laboratory case narratives)

Percent recovery (%R) for surrogates, LCS, and MS is calculated using the following formula:

$$\%\ Recovery = \frac{(S - U)}{C_{sa}}\ x\ 100$$

Where: S = measured concentration in spiked aliquot

U = measured concentration in unspiked aliquot

C_{sa} = actual concentration of spike added

Representativeness

Representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Representativeness will be evaluated by reviewing the following:

- Sampling design, including sample quantities and locations
- Sampling procedures and equipment
- Sample chain-of-custody (CoC) forms and field logbooks
- Holding times and preservation

Completeness

Completeness is a measure of the amount of valid data obtained compared with the amount that was expected to be obtained under correct, normal conditions. Completeness will be evaluated for each analyte for a particular sampling event or other defined set of samples (such as by AOC) with respect to each DQO or end data use. Completeness will be calculated and evaluated for each method, matrix and analyte combination using the following formula:

$$\%\ Completeness = 100\ x\ (\frac{V}{n})$$

Where: V = number of measurements determined to be valid (not rejected)

n = total number of measurements

Valid data are considered usable in the context of project DQOs and/or end data use(s). The completeness goal is considered met when 95% of the sample data are considered valid and usable in the context of project goals.

Comparability

Comparability is a qualitative indicator of the confidence with which one data set can be compared to another. To ensure data set comparability, the following steps will be taken:

- Using standard methods for sampling and analysis.
- Reporting data in standard units.
- Operating Instruments within their calibrated range according to established procedures that are based on approved methodology.
- Using only standards supplied by the field test kit manufacturer for field screening analysis.
- Using standard and comprehensive reporting formats.

Sensitivity

Sensitivity is the ability of a method or instrument to detect the target analytes at the level of interest. The capability of analytical laboratory methods and instrumentation to provide data with the sensitivity to meet the DQOs is evaluated during the planning phase. The laboratory-specific limits (including DLs, LODs, and limits of quantitation [LOQs]) are evaluated against the PALs to determine whether the analytical methods and/or laboratory can meet the project DQOs. Laboratory reference limits for the planned fields of testing are included in Worksheet 15.

If a result is greater than the DL and less than the LOQ, the result will be reported by the laboratory as a detected concentration and flagged "J." If no detected concentration is determined down to the DL, the result will be reported by the laboratory to the LOD concentration (with the added variables of sample dilution, final volume, and sample mass included), reported as a non-detect (ND) result, and U-flagged. A

detected result greater than or equal to the LOQ will be reported without a qualifying flag unless otherwise required by QC exceedance.

Sample dilution due to target and/or nontarget compound concentrations or matrix interference could prevent achievement of DLs. Samples must be analyzed initially while undiluted, when reasonable. If dilution is necessary, both the original and the diluted results must be reported. Samples that are not analyzed undiluted must be supported by matrix interference documentation, such as sample viscosity, color, odor, or results from other analyses of the same sample, to show that undiluted analysis is not possible. Appropriate cleanup procedures must be followed to minimize matrix effects on DLs, LODs, and LOQs.

Matrix: Soil/Supra-permafrost porewater
Analytical Group or Method: DRO by AK102, RRO by AK103
Concentration Level: Low-High

Table 12-1 Measurement Performance Criteria for Methods AK102 and AK103

Analytical Method/SOP	QC Sample or Measurement Performance Activity	Data Quality Indicator	Measurement Performance Criteria
AK 102/AK103	FD	Precision	RPD <50% for soil[1] RPD <30% for water[1]
	Blanks (MB)	Accuracy/Bias/Contamination	No analytes detected >1/2 LOQ and >1/10 the amount found in any sample. For common laboratory contaminants, no analytes detected >LOQ and >1/10 the amount measured in any sample.[2] Sample results will be qualified if contamination is detected above the DL in the associated MB.
	LCS/LCSD Recoveries MS/MSD Recoveries	Accuracy	DRO: 75 to 125% Recovery[3] RRO: 60 to 120% Recovery[3]
	LCS/LCSD Recoveries MS/MSD Recoveries	Precision	RPD ≤20%[3]
	Surrogate Recoveries	Accuracy	60 to 120% Recovery for QC samples (MB/LCS/LCSD)[3] 50 to 150% Recovery for field samples (including MS/MSD)[3]
	ICV and CCV	Accuracy/Bias	75 to 125% Recovery[2]
	Collection time/date, extraction time/date, analysis time/date	Representativeness/Usability	Samples must be extracted and analyzed within holding times (14 days to extraction, 40 days to analysis)
	Cooler Temperature and Temperature Blank	Representativeness/Usability	Temperature 0° to 6°C[1]
	Evaluate laboratory LODs and LOQs against project DQOs	Sensitivity	LOD for ND results less than the PAL
	Completeness of samples collected; completeness of analytical requirements per the QAPP	Completeness	95% for all matrices

Notes:
For definitions, refer to the Acronyms and Abbreviations section.
[1] *Field Sampling Guidance* (ADEC 2022)
[2] DoD QSM (DoD 2021b)
[3] *Underground Storage Tank Procedures Manual* (ADEC 2017c)

Matrix: Soil/Supra-permafrost porewater
Analytical Group or Method: BTEX (VOCs) by SW8260D
Concentration Level: Low-High

Table 12-2 Measurement Performance Criteria for Method SW8260D

Analytical Method/SOP	QC Sample or Measurement Performance Activity	Data Quality Indicator	Measurement Performance Criteria
SW 8260D	FD	Precision	RPD <50% for soil[1] RPD <30% for water[1]
	Blanks (MB, Trip Blank)	Accuracy/Bias/Contamination	No analytes detected >1/2 LOQ and >1/10 the amount found in any sample. For common laboratory contaminants, no analytes detected >LOQ and >1/10 the amount measured in any sample.[2] Sample results will be qualified if contamination is detected above the DL in the associated MB.
	LCS and MS/MSD Recoveries	Accuracy	Soil: DoD QSM Table C-23[2] Water: DoD QSM Table C-24[2]
	MS/MSD Recoveries (and LCS/LCSD, if performed)	Precision	RPD ≤20%[2]
	Surrogate Recoveries	Accuracy	Soil: DoD QSM Table C-23[2] Water: DoD QSM Table C-24[2]
	ICV and CCV	Accuracy/Bias	≤20% difference (≤50% for end of analytical batch CCV)[2]
	Internal Standards (IS)	Representativeness/Usability	Retention time (RT) ±10 seconds from RT of the IS of the calibration midpoint and extracted ion current profile area within -50% to +100% of area from IS calibration midpoint standard
	Collection time/date, extraction time/date, analysis time/date	Representativeness/Usability	Samples must be extracted and analyzed within holding times (Soil and Water: 14 days to analysis)
	Cooler Temperature and Temperature Blank	Sensitivity	Temperature 0° to 6°C[1]
	Evaluate laboratory LODs and LOQs against project DQOs	Completeness	LOD for ND results less than the PAL

Notes:
For definitions, refer to the Acronyms and Abbreviations section.
[1] *Field Sampling Guidance* (ADEC 2022)
[2] DoD QSM (DoD 2021b)
[3] *Underground Storage Tank Procedures Manual* (ADEC 2017c)

Matrix: Soil/Supra-permafrost porewater
Analytical Group or Method: PAHs by SW8270D SIM
Concentration Level: Low-High

Table 12-3 Measurement Performance Criteria for Method SW8270D SIM

Analytical Method/SOP	QC Sample or Measurement Performance Activity	Data Quality Indicator	Measurement Performance Criteria
SW 8270D SIM	FD	Precision	RPD <50% for soil[1] RPD <30% for water[1]
	Blanks (MB)	Accuracy/Bias/Contamination	No analytes detected >1/2 LOQ and >1/10 the amount found in any sample. For common laboratory contaminants, no analytes detected >LOQ and >1/10 the amount measured in any sample.[2] Sample results will be qualified if contamination is detected above the DL in the associated MB.
	LCS and MS/MSD Recoveries	Accuracy	Soil: DoD QSM Table C-27[2] Water: DoD QSM Table C-28[2]
	MS/MSD Recoveries (and LCS/LCSD, if performed)	Precision	RPD ≤40%[2]
	Surrogate Recoveries	Accuracy	Soil: DoD QSM Table C-27[2] Water: DoD QSM Table C-28[2]
	ICV and CCV	Accuracy/Bias	≤20% difference (≤50% for end of analytical batch CCV)[2]
	Internal Standards (IS)	Representativeness/Usability	RT ±30 seconds from RT of the IS of the calibration midpoint and extracted ion current profile area within -50% to +100% of area from IS calibration midpoint standard[2]
	Collection time/date, extraction time/date, analysis time/date	Representativeness/Usability	Samples must be extracted and analyzed within holding times (Soil: 14 days to extraction, 40 days to analysis; Water: 7 days to extraction, 40 days to analysis)
	Cooler Temperature and Temperature Blank	Sensitivity	Temperature 0° to 6°C[1]
	Evaluate laboratory LODs and LOQs against project DQOs	Completeness	LOD for ND results less than the PAL

Notes:
For definitions, refer to the Acronyms and Abbreviations section.
[1] *Field Sampling Guidance* (ADEC 2022)
[2] DoD QSM (DoD 2021b)
[3] *Underground Storage Tank Procedures Manual* (ADEC 2017c)

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WORKSHEET 13 – SECONDARY DATA USES AND LIMITATIONS

Historical reports prepared for the Savoonga FSA were used to develop the previous investigation and CSM sections of Worksheet 10. Analytical results were compiled as reported by previous contractors regardless of analytical method, data quality flagging, or method reporting limit sufficiency. Figures were prepared using previous reports. Locations are estimated based on scaled drawings and may have uncertainty in spatial accuracy. Table 13-1 lists the secondary data used as reported for project planning.

Table 13-1 Secondary Data Uses and Limitations

Secondary Data	Data Source	How Data Will Be Used, Data Types, Data Collection Dates	Factors Affecting Data Reliability/ Limitations on Data Use
Source area locations	*Preliminary Assessment/Site Investigation at the Savoonga Federal Scout Armory Savoonga, Alaska*	January 1998. Historical information for relocation of potential sources	General location descriptions only
Source area locations	*Preliminary Assessment Records Review Remedial Investigation Army National Guard Scout Armory Savoonga, Alaska*	July 1998. Historical information for relocation of potential sources	General location descriptions only
Analytical Data and Field observations	*Final remedial Investigation Alaska Army National Guard Armory Savoonga, Alaska*	April 1999. Support design of the Remedial Investigation sampling approach	Only laboratory analyzed analytical data will be used, combined BTEX analysis will not be screened against PALs
Analytical data, site-specific soil parameters, and field observations	*Alternate Cleanup Level Demonstration Project Savoonga FSA*	18 May 2006. Support design of the Remedial Investigation sampling approach	None
Analytical data, site-specific soil parameters, and field observations	*Draft Secondary Site Characterization Report*	July 2009. Support design of the Remedial Investigation sampling approach	None

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WORKSHEET 14/16 – PROJECT TASKS AND SCHEDULE

Table 14-1 provides the proposed schedule for the completion of the major project tasks. Each task is further described in Worksheet 17.

Table 14-1 Project Schedule

Activity	Organization	Anticipated Initiation Date	Deliverable(s)	Anticipated Deliverable Date
Prepare Pre-Draft Work Plan	Brice	10/25/21	Pre-Draft Work Plan	1/24/22
Pre-Draft Work Plan Review	USACE, AKARNG	1/24/22	Comments	2/22/22
Respond to Comments	Brice	2/23/22	Responses to Comments	3/9/22
Prepare Draft Work Plan	Brice	3/10/22	Draft Final Work Plan	3/24/22
Draft Work Plan Review	ADEC	3/25/22	Comments	4/23/22
Respond to Comments	Brice	4/24/22	Responses to Comments	5/8/22
Prepare Draft-Final Work Plan	Brice	5/9/22	Draft-Final Work Plan	5/23/22
Draft-Final Work Plan Review	USACE, AKARNG, ADEC	5/24/22	Comments	6/22/22
Respond to Comments	Brice	6/23/22	Responses to Comments	7/7/22
Prepare Final Work Plan	Brice	7/8/22	Final Work Plan	7/22/22
Fieldwork	Brice	8/1/22	Progress Updates	Daily (ending around 8/9/2022)
Prepare Pre-Draft RA Report	Brice	8/24/22	Pre-Draft RA Report	11/22/22
Pre-Draft RA Report Review	USACE, AKARNG	11/23/22	Comments	12/7/22
Respond to Comments	Brice	12/8/22	Responses to Comments	12/22/22
Prepare Draft RA Report	Brice	12/23/22	Draft Report	1/6/23
Draft RA Report Review	ADEC	1/7/23	Comments	1/21/23
Respond to Comments	Brice	1/22/23	Responses to Comments	2/5/23
Prepare Draft-Final RA Report	Brice	2/6/23	Draft-Final Report	2/20/23
Draft-Final RA Report Review	USACE, AKARNG, ADEC	2/21/23	Comments	3/7/23

Table 14-1 Project Schedule

Activity	Organization	Anticipated Initiation Date	Deliverable(s)	Anticipated Deliverable Date
Respond to Comments	Brice	3/8/23	Responses to Comments	3/14/23
Prepare Final RA Report	Brice	3/15/23	Final Report	3/29/23

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

WORKSHEET 15 – PROJECT ACTION LIMITS AND LABORATORY-SPECIFIC DETECTION/QUANTITATION LIMITS

This worksheet and associated tables provide target analyte lists, analytical methods, project action limits, and other screening levels. The purpose of this worksheet and associated tables is to demonstrate that the selected analytical laboratory and analytical methods can provide accurate data (i.e., quantitative results with known precision and bias) at the project action limit(s) or other screening levels. To meet MPC for sensitivity, the LODs for non-detections and the LOQs for detections shall be less than the PALs.

For soil samples, PALs are defined by the ADEC-approved ACLs calculated in 2020 (Brice 2021). Analytes not included in the ACLs will be defined by 18 AAC 75 Method Two , Table B1 Soil Cleanup Levels (ADEC 2021). Analytical results for soil samples will be compared to the cleanup levels and laboratory specific limits included in Table 15-1.

The PALs for supra-permafrost porewater are defined by the ADEC-approved ACLs calculated in 2020 (Brice 2021), which are equivalent to 18 AAC 75 Table C Groundwater Cleanup Levels (ADEC 2021). Analytical results for supra-permafrost porewater samples will be compared to the cleanup levels and laboratory-specific limits included in Table 15-2

Laboratory DL, LOD, and LOQ are included in each table for the planned chemical analyses. SGS in Anchorage, Alaska will be the primary laboratory for the project. The laboratory LOQs, LODs, and DLs presented in the following tables represent the achievable limits for analytes in a laboratory matrix. Additionally, the analysis of field samples may result in sample dilutions that cause laboratory reporting limits to be elevated above PALs. The ND results will be reported to the LOD; if the LOD is above the PAL, then it cannot be definitively said that the analyte is not present at or below the PAL. The ND sample results with LOQs and LODs that exceed the PALs will be evaluated for potential effects on the usability of these data with regards to project DQOs.

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Table 15-1 Project Action Limits and Laboratory-Specific Limits by Analyte – Soil

Analyte	Method	CAS Number	ADEC[1] (mg/kg)	ACL[2] (mg/kg)	PAL[3] (mg/kg)	Laboratory Limits[4] (mg/kg)		
						DL	LOD	LOQ
DRO	AK102	NS	250	3000	250	9.0	10	20
Benzene	SW8260D	71-43-2	0.022	0.13	0.13	0.0039	0.00625	0.0125
Ethylbenzene	SW8260D	100-41-4	0.13	1.2	0.13	0.0078	0.0125	0.025
Xylenes (total)	SW8260D	1330-20-7	1.5	13	1.5	0.0228	0.0375	0.075
Toluene	SW8260D	108-88-3	6.7	47	6.7	0.0078	0.0125	0.025
1-Methylnaphthalene	SW8270D SIM	90-12-0	0.41	4.9	0.41	0.00625	0.0125	0.025
2-Methylnaphthalene	SW8270D SIM	91-57-6	1.3	15	1.3	0.00625	0.0125	0.025
Acenaphthene	SW8270D SIM	83-32-9	37	NS	37	0.00625	0.0125	0.025
Acenaphthylene	SW8270D SIM	208-96-8	18	NS	18	0.00625	0.0125	0.025
Anthracene	SW8270D SIM	120-12-7	390	NS	390	0.00625	0.0125	0.025
Benzo(a]anthracene	SW8270D SIM	56-55-3	0.7	NS	0.7	0.00625	0.0125	0.025
Benzo(a]pyrene	SW8270D SIM	50-32-8	1.9	NS	1.9	0.00625	0.0125	0.025
Benzo(b)fluoranthene	SW8270D SIM	205-99-2	20	NS	20	0.00625	0.0125	0.025
Benzo(g,h,i)perylene	SW8270D SIM	191-24-2	15000	NS	15000	0.00625	0.0125	0.025
Benzo(k)fluoranthene	SW8270D SIM	207-08-9	190	NS	190	0.00625	0.0125	0.025
Chrysene	SW8270D SIM	218-01-9	600	NS	600	0.00625	0.0125	0.025
Dibenzo(a,h)anthracene	SW8270D SIM	53-70-3	6.3	NS	6.3	0.00625	0.0125	0.025
Fluoranthene	SW8270D SIM	206-44-0	590	NS	590	0.00625	0.0125	0.025
Fluorene	SW8270D SIM	86-73-7	36	NS	36	0.00625	0.0125	0.025
Indeno(1,2,3-cd) pyrene	SW8270D SIM	193-39-5	65	NS	65	0.00625	0.0125	0.025
Naphthalene	SW8270D SIM	91-20-3	0.038	0.43	0.43	0.005	0.01	0.02
Phenanthrene	SW8270D SIM	85-01-8	39	NS	39	0.00625	0.0125	0.025
Pyrene	SW8270D SIM	129-00-0	87	NS	87	0.00625	0.0125	0.025

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

[1]The most stringent of 18 AAC 75 Method Two Table B1 and B2, Under 40 Inch Human Health and Migration to Groundwater cleanup levels (ADEC 2021).

[2]ACLs are defined by the Soil Contaminants of Concern and Cleanup Goals, as approved by ADEC on 30 July 2020 (ROD)

[3]PALs are defined by the ACLs or ADEC 18 AAC 75 Method Two Migration to Groundwater cleanup levels when there is no ACL in place

[4] Laboratory limits for all methods from SGS - Anchorage, AK

Table 15-2 Project Action Limits and Laboratory-Specific Limits by Analyte – Supra-permafrost Porewater

Analyte	Method	CASRN	PAL[1] (mg/L)	Laboratory-Specific RLS[2] (µg/L)		
				DL	LOD	LOQ
DRO	AK102 LV	NS	1500	200	300	600
RRO	AK103 LV	NS	1100	200	250	500
Benzene	SW8260D	71-43-2	4.6	0.12	0.2	0.4
Ethylbenzene	SW8260D	100-41-4	15	0.31	0.5	1.0
Toluene	SW8260D	108-88-3	1100	0.31	0.5	1.0
Xylenes (total)	SW8260D	1330-20-7	190	1.0	1.5	3.0
1-Methylnaphthalene	SW8270D SIM LV	90-12-0	11	0.015	0.025	0.05
2-Methylnaphthalene	SW8270D SIM LV	91-57-6	36	0.015	0.025	0.05
Acenaphthene	SW8270D SIM LV	83-32-9	530	0.015	0.025	0.05
Acenaphthylene	SW8270D SIM LV	208-96-8	260	0.015	0.025	0.05
Anthracene	SW8270D SIM LV	120-12-7	43	0.015	0.025	0.05
Benzo(a)anthracene	SW8270D SIM LV	56-55-3	0.3	0.015	0.025	0.05
Benzo(a)pyrene	SW8270D SIM LV	50-32-8	0.25	0.0062	0.01	0.02
Benzo(b)fluoranthene	SW8270D SIM LV	205-99-2	2.5	0.015	0.025	0.05
Benzo(g,h,i)perylene	SW8270D SIM LV	191-24-2	0.26	0.015	0.025	0.05
Benzo(k)fluoranthene	SW8270D SIM LV	207-08-9	0.8	0.015	0.025	0.05
Chrysene	SW8270D SIM LV	218-01-9	2	0.015	0.025	0.05
Dibenzo(a,h)anthracene	SW8270D SIM LV	53-70-3	0.25	0.0062	0.01	0.02
Fluoranthene	SW8270D SIM LV	206-44-0	260	0.015	0.025	0.05
Fluorene	SW8270D SIM LV	86-73-7	290	0.015	0.025	0.05
Indeno(1,2,3-cd)pyrene	SW8270D SIM LV	193-39-5	0.19	0.015	0.025	0.05
Naphthalene	SW8270D SIM LV	91-20-3	1.7	0.031	0.05	0.1
Phenanthrene	SW8270D SIM LV	85-01-8	170	0.015	0.025	0.05
Pyrene	SW8270D SIM LV	129-00-0	120	0.015	0.025	0.05

Notes:
For definitions, refer to the Acronyms and Abbreviations section.
[1]PALs are defined by 18 AAC 75 Table C Groundwater cleanup levels (ADEC 2021)
[2] Laboratory limits for all methods from SGS - Anchorage, AK

WORKSHEET 17 – SAMPLING DESIGN AND RATIONALE

This Worksheet describes general field investigation activities and the rationale for each project task. The sampling objectives and rationale are summarized in the DQO tables provided in Worksheet 11. Sampling locations and methods are provided in Worksheet 18. Field activities will be conducted in accordance with the SOPs listed on Worksheet 21 and provided in Appendix B. Definable features of work are described in the following sections along with the rationale for each task, if applicable.

Utility Locates/Site Reconnaissance

General utility locates will be performed by calling the Alaska Digline at 811 at least 10 working days prior to drilling tasks and contacting the village council office to request utility maps and onsite consultation. In addition to the general area utility locating process, screening for buried utilities onsite will be completed using a Schondstedt magnetometer. Site drawings and owner knowledge will also be used in line locating activities. During buried utility locating, a visual reconnaissance will be conducted to identify any surface features that may impede the main project objectives or impact contaminant evaluation. Surface features may include debris, ASTs and drums, soil staining, and topological features such as depressions or preferential flow pathways.

Field Screening

Field screening will be conducted using a photoionization detector (PID) and headspace screening procedures. PID field screening will be conducted to identify potential petroleum contamination and to guide the excavation and collection of analytical samples. Field screening samples will be collected in accordance with the procedures in BE-SOP-15 *Field Screening with PID* (Appendix B) and ADEC guidance. Tables 17-1 and 17-2 summarize the minimum number of soil field screening samples that will be collected from the excavated soil and excavation limits. Overburden soil is not anticipated. The sample collection time will be recorded in a field logbook with the associated sample number.

Table 17-1 Excavated Soil Sample Collection Guide

By Volume (cy)	Number of Field Screening Samples	Associated Number of Laboratory Samples
0-10	5	1
11-50	5	2
51-100	1 per 10 cy	3
More than 100	1 per 10 cy	3 samples, plus 1 sample for each additional 200 cy or portion thereof

Table 17-2 Surface/Excavation Base and Sidewall Soil Sample Collection Guide

Surface Area (square feet)	Number of Field Screening Samples	Associated Number of Laboratory Samples
0-50	5	1
51-124	5	2
125-250	1 per 25 square feet	3
More than 250	10 plus 1 per additional 100 square feet	2 samples, plus 1 sample for each additional 250 square feet, or portion thereof
Excavation Sidewalls	For each excavation sidewall, 1 per 10 square feet, or portion thereof, with field screening sample collection focused on soil horizons demonstrated as most likely to be contaminated.	Minimum 1 per each sidewall plus one additional sample for each sidewall areas over 250 total square feet (depth and length), or portion thereof at the highest field screening reading in all soil horizons.

Soil Sampling

A small excavator will be used to excavate contaminated soil from the source area. Soil will be placed into 1 cy supersacks for transport and disposal. To minimize volatilization during soil sampling for volatiles (BTEX), approximately six inches of soil will be removed from the base and sidewalls immediately prior to sample collection, and approximately 25 to 50 grams of soil will be placed in a pre-weighed amber 4-ounce (oz) sample jar with Teflon lined lid and septum as soon as possible after the soil is exposed. Immediately after collection, 25 milliliters (mL) of methanol will be added so the sample is submerged. If all the methanol is absorbed leaving exposed soil, a second vial of 25 mL will be added, noted in the field notes, on the jar lid ("MeOHx2"), and noted on the chain of custody form. Samples will be collected with clean stainless steel or disposable sampling tools, and care will be taken to minimize soil disturbance during sample collection. Soil samples will be collected using a clean, stainless steel sampling spoon, and sampling personnel will wear new nitrile gloves for each sample. Samples will be placed in laboratory-provided glass jars with Teflon-lined lids, labeled in accordance with the WP, placed in a chilled sample cooler, and submitted to the laboratory for analysis.

Soil samples will be submitted and analyzed in accordance with Table 18-1 on Worksheet 18. Soil samples will be analyzed for DRO, BTEX, and PAHs.

Excavation and soil sampling will be conducted in accordance with the ADEC *Field Sampling Guidance* (ADEC 2022) and BE-SOP-06 Soil Sampling (Appendix B). Tables 17-1 and 17-2 summarize the minimum number of confirmation soil samples that will be collected from the excavated soil and excavation limits.

Porewater Investigation

Monitoring wells will be installed, developed, and sampled to evaluate the nature and extent of contamination in supra-permafrost porewater. Proposed monitoring well installation, development, and sampling activities are described in the following subsections.

Monitoring Well Construction

Four temporary monitoring wells will be excavation installed, in accordance with ADEC Monitoring Well Guidance (ADEC 2013), to the east and south of the source area. Monitoring well locations will be selected in the field; however, proposed locations are shown on Figure 5. Temporary monitoring wells will be constructed with 5 feet of 1-inch PVC well screen and 1-inch PVC risers. Silica sand will be placed in the well annulus around the well screen and at least 1 foot above the well screen. Monitoring wells are expected to be installed between 2 and 6 feet bgs and will be screened to capture the supra-permafrost porewater layer, typically found between 2 and 4 feet bgs.

When the sampling and survey of the temporary monitoring wells is complete, the PVC will be removed from the ground. The boring will be backfilled with its own soil cuttings.

Monitoring Well Development

The temporary monitoring wells will be developed using a peristaltic pump (or equivalent). Each well location will be developed by purging the well until the water clears substantially, or the well purges dry. Upon completion of the development of the well, a waiting period will allow the well to return to within approximately 80% of the measured water level during well installation, prior to sampling. Dedicated tubing will be used for each well to minimize the potential for cross-contamination between well locations. Porewater parameters will be monitored for stability criteria at the time of sampling. Well installation and development will be conducted in accordance with the ADEC *Monitoring Well Guidance* (ADEC 2013) and the ADEC *Field Sampling Guidance* (ADEC 2022). Sampling will only be conducted as soon as porewater has re-equilibrated, is free of visible sediment, water quality parameters have stabilized, or 24 hours have passed following development.

Porewater Sampling

After installation and development, supra-permafrost porewater samples will be collected in accordance with low-flow sampling procedures based on the EPA and ADEC guidelines (EPA 1996; ADEC 2022) and BE-SOP-09 *Groundwater Sample Collection* (Appendix B). Monitoring wells will be sampled using a pneumatic bladder pump with a dedicated bladder and tubing and BE-SOP-20 *Water Quality Measurements*, BE-SOP-21 *Groundwater and LNAPL Measurements*, and BE-SOP-09 *Groundwater Sample Collection* (Appendix B). The pump intake will be set at the approximate midpoint of the wetted area of the screened interval. Supra-permafrost porewater samples will be submitted and analyzed in accordance with Table 11-1. Supra-permafrost porewater samples will be analyzed for DRO/RRO, BTEX, and PAHs.

Prior to sample collection, each monitoring well will be gauged using a water level meter (Appendix B, BE-SOP-21 *Groundwater and LNAPL Measurements*) and purged using low-flow methods, if possible. If a well is purged dry, it will be allowed to recharge for 24 hours. Without further purging, the well will be sampled. When sufficient yield is available, monitoring well parameters will be stabilized prior to sample collection. A YSI 556 water quality meter with a flow-through cell and turbidity meter will be used to monitor field parameters for stabilization (Appendix B, *BE-SOP-20 Water Quality Measurements*). In addition to parameter stabilization, drawdown during purging will not exceed 0.3 foot (at a minimum flow rate of approximately 50 to 100 milliliters per minute [mL/min]), when possible. After stabilization, volatile samples will be collected followed by non-volatile samples (Appendix B, BE-SOP-09 *Groundwater Sample Collection*). Worksheet 18 presents sampling locations and methods.

Decontamination

Down-hole drilling equipment (e.g., rods, drill bits, augers) will be decontaminated between borings using a water and Alconox mixture. Decontamination water will be collected in a tub or 55-gallon drum. Smaller items including hand tools, soil sampling equipment (e.g., spoons, bowls, trowels), and non-dedicated water sampling/monitoring equipment (e.g., bladder pumps, water level meters) will be decontaminated between samples to prevent cross-contamination. Decontamination of these smaller items will consist of washing the equipment with a mixture of potable water and Alconox, followed by a deionized or distilled water rinse. The water generated during decontamination activities will be collected in a tub or 55-gallon drum (drilling equipment), or 5-gallon buckets with screw-top lids (smaller hand tools). Decontamination water will be filtered using a granular activated carbon (GAC) filter and discharged at the point of origin. Decontamination procedures are detailed in BE-SOP-14 *Equipment Decontamination* (Appendix B).

Waste Management

Wastes generated during field activities will be managed in accordance with the procedures described in the following subsections. ADEC approval will be required prior to transport and disposal of any investigative-derived waste (IDW).

Liquid Waste

Liquid IDW, including purge water from porewater sampling and development activities and decontamination water, will be generated during the RA. Water will be collected in DOT-approved 5-gallon buckets with screw-top lids, or in 55-gallon drums, and passed through a portable GAC unit near the point of generation. The water will be visually inspected for sheen and discharged to a vegetated area at the site. Discharge points will be at least 100 feet from surface water bodies. At the end of the field event, the spent GAC material will be placed in a DOT-approved, 55-gallon drum with the soil cuttings for offsite disposal.

One 5-gallon GAC unit filled with commercial GAC will be used. According to commercial GAC specifications and published contaminant data, the GAC unit is calculated to treat 4,090 gallons of water with naphthalene concentrations up to 150 mg/L to below regulatory limits, at an estimated flow rate of 5 gallons per minute. Naphthalene was used as a representative compound for the other petroleum compounds that will be treated during project activities. Compounds anticipated during project activities such as hydrocarbons with high molecular weights are considered readily adsorbed organics. Additionally, it is expected that less than 25 gallons of water will be treated throughout the project activities, so the GAC has a significantly higher capacity than needed and no breakthrough is expected. Treated water volume will be tracked to ensure these volumes are not exceeded.

Solid Waste

Solid wastes generated during the field effort may include personal protective equipment (PPE) (e.g., nitrile gloves, hearing protection), dedicated sampling equipment (e.g., tubing, Teflon bladders), empty sample bottles, and miscellaneous trash (e.g., plastic bags, cardboard, paper towels, plastic sheeting). Wastes will be stored in plastic trash bags and transported to either the Nome or Anchorage municipal landfill for disposal as non-regulated waste. Excavated soil placed in supersacks will be sampled for RCRA metals. In the event that the RCRA metals results are less than maximum concentrations of contaminants for the toxicity characteristic, the cuttings will be disposed of according to the analytical results generated

from the installation of the borings, such as hydrocarbon data. Soil will be transported offsite for disposal at the Columbia Ridge Landfill in Arlington, Oregon.

Soil cuttings generated from temporary monitoring well installations will be placed back in the borehole of origin after porewater sampling. If the boring collapses prior to replacement of soil in the hole or during monitoring well installation, the soil will be placed in 1 cy supersacks along with excavated materials from the source area for transport and disposal.

Survey

Excavation boundaries, confirmation samples, monitoring wells, existing monuments, and other pertinent features will be surveyed using Global Navigation Satellite System (GNSS) real-time kinematic (RTK) and conventional total station surveying techniques. In environments where RTK is not suitable, post-processed GNSS static techniques may also be used. Horizontal control will be referenced to the World Geodetic System 1984 datum (WGS84), decimal degrees. Vertical control will be referenced to the North American Vertical Datum of 1988 (NAVD88). If a GNSS base station is not accessible or within a required usability range, one will be established to tie survey data into the National Spatial Reference System, and a minimum of two hours of static Global Positioning System (GPS) data will be collected for Online Positioning User Service post-processing.

The four temporary monitoring wells will be surveyed at the top of the well casing at a marked measuring point on the northernmost edge of the top of the well casing. Temporary monitoring wells and soil borings will be located horizontally to 3.3 feet reported in the geographic coordinate system WGS84 datum with coordinates in latitude and longitude in decimal degrees. Soil borings will be located vertically to 0.1 foot. Temporary monitoring wells will be located vertically to 0.01-foot in the NAVD88 in feet.

Site Restoration

The excavation will be backfilled with clean material from a local borrow source and compacted to match the existing grade and surrounding material. The backfill will be mounded slightly to allow for settling and then contoured in a way to prevent water accumulation and promote drainage.

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WORKSHEET 18 – SAMPLING LOCATIONS AND METHODS

The sample IDs, matrices, depths, analytes, methods, and associated SOPs are listed in Table 18-1 below. Anticipated sample locations are displayed, and additional information describing the methods that will be used for this project are described in Worksheet 17. Field SOPs detailing sampling methods are listed on Worksheet 21, and provided in Appendix B.

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Table 18-1 Sample Locations, Identifiers, Depths, Field QA/QC Samples, and Analytical Methods

Sample ID[1]	Matrix[2]	Sample Type	Sample Location	Sample Depth	Sampling SOP Reference	Collection Method	Sample Quantity and Analysis				Additional Tasks
							DRO AK102 RRO AK103*	PAH SW8270D SIM	BTEX SW8260D	RCRA Metals SW6020A	
22SAV-SW01-X-X through 22SAV-SW04-X-X 22SAV-B01-X-X through 22SAV-B05-X-X	S	Discrete	Sample locations will be on the sidewalls (SW) and base (B) of the excavation. See Figure 5 for proposed excavation limits. Sample locations will be determined in the field based on elevated PID screening results and visual and/or olfactory observations.	Collect primary analytical sample from most contaminated locations on sidewalls and base of excavation based on field observations (elevated PID screening results and visual and/or olfactory observations).	BE-SOP-04	Discrete sampling methods	20	20	20		"X-X" to be replaced with depth interval.
22SAV-SW019-X-X 22SAV-B019-X-X through 22SAV-SW049-X-X 22SAV-B059-X-X	S	Field Duplicate/ Discrete	Collect and submit at a frequency of one for every 10 or fewer primary samples for each target analyte. Collect a minimum of one per day if 10 or more samples are collected. Collect from locations of suspected contamination at the same time and location as the primary sample and submit to the laboratory blind with unique sample identification numbers	Collect at a location corresponding to a primary soil sample.	BE-SOP-04	Discrete sampling methods	2	2	2		"X-X" to be replaced with depth interval.
22SAV-SW01-X-X through 22SAV-SW04-X-X 22SAV-B01-X-X through 22SAV-B05-X-X	S	Matrix Spike/ Matrix Spike Duplicate	Collect and submit at a frequency of one set for every preparatory batch of 20 or fewer primary samples (5%).	Collect and submit triplicate volume (except BTEX) at one primary location outside the contaminated area	BE-SOP-04	Discrete sampling methods	1	1	1		"X-X" to be replaced with depth interval.
22SAV-TB01	S	Trip Blank	One trip blank will accompany each cooler that contains GRO or BTEX samples.	NA	BE-SOP-04	NA			2		Provided by the laboratory.
22SAV-WP01 through 22SAV-WP05	W	Low-Flow	Convert five soil borings located upgradient, downgradient, cross gradient, and in source to temporary monitoring wells, if possible.	Install well at the depth of permafrost or near the top of the porewater interface, if observed; collect sample primary analytical sample from mid-water column.	BE-SOP-09 BE-SOP-21	Bladder pump	5	5	5		
22SAV-WP0X9	W	Field Duplicate/ Low-Flow	Collect from a temporary monitoring well most likely to be contaminated.	Collect from a temporary monitoring well corresponding to a primary porewater sample.	BE-SOP-04 BE-SOP-09 BE-SOP-21	Bladder pump	1	1	1		"X" to be replaced with temporary monitoring well number.
22SAV-WP01 through 22SAV-WP05	W	Matrix Spike/ Matrix Spike Duplicate/ Low-Flow	Collect and submit at a frequency of one set for every preparatory batch of 20 or fewer primary samples (5%).	Collect from a temporary monitoring well corresponding to a primary sample location outside of the contaminated area.	BE-SOP-04 BE-SOP-09 BE-SOP-21	Bladder pump	1	1	1		
22SAV-EB01	W	Equipment Blank	Collected from porewater monitoring equipment at a frequency of one for every 20 or fewer porewater samples (5%).	NA	BE-SOP-04	NA	1	1	1		
22SAV-TB01	W	Trip Blank	One trip blank will accompany each cooler that contains BTEX samples.	NA	BE-SOP-04	NA			1		Provided by the laboratory.
22SAV-WC01	S	Composite	Soil cuttings waste	NA	BE-SOP-06	hand tools				1 TCLP	

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

[1]The "X-X" in the soil sample IDs will be replaced with the depth interval of the sample.

[2]Matrix S - solid, Matrix W – water

*AK103 included for Porewater samples only.

WORKSHEET 19/30 – SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES

Table 19-1 provides the preparation and analytical method/SOP, container specifications, preservation requirements, and maximum holding times for each matrix and analytical group. Analytical SOPs are kept on file and will be provided upon request.

Laboratory: SGS North America, Inc.

200 W Potter Drive, Anchorage, AK 99518; (907) 550-3205

Accreditation/Certifications: Alaska Certification number 17-021 (Expires 01/31/2024)
DoD ELAP Certification (Expires 12/31/2023)

Sample Delivery Method: Hand Deliver

Table 19-1 Sample Containers, Preservation, and Hold Times – SGS North America, Inc.

Analyte(s)	Laboratory SOP Reference[1]	Containers	Preservation	Preparation/Analytical Holding Time
Soil				
DRO	SW3550B/SW3546/ AK102 712r18	4-oz amber glass jar w/TLC	0-6°C	14/40 days
PAH	SW3550B/ SW3546/ SW8270D SIM 727r13_PAH			
BTEX	SW5035A/SW8260D	4-oz pre-tared amber glass jars w/TLS (50 g soil, 25 g methanol)	0-6°C, MeOH w/BFB surrogate	NA/14 days
	783r06_VMS_8260D			
Supra-Permafrost Porewater				
DRO/RRO (Low volume)	SW3510C AK102/AK103 712r18	2x250-mL amber glass, TLC	0-6°C, HCl to pH<2	14/40 days
PAH (Low volume)	SW3510C/SW3520C/ SW8270D SIM 727r13_PAH	2x250-mL amber glass, TLC	0-6°C	7/40 days
BTEX	SW5030B/SW8260D 783r06_VMS_8260D	3x 40-mL VOA vials, TLS	0-6°C, HCl to pH<2	NA/14 days

Notes:
For definitions, refer to the Acronyms and Abbreviations section.
[1]See Worksheet 23.
[2] Maximum preparation holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted. Maximum analytical holding time is calculated from the time the sample is prepared/extracted to the time the sample is analyzed.

WORKSHEET 20 – FIELD QUALITY CONTROL SUMMARY

This Worksheet summarizes the type and frequencies of field primary and QC samples that will be collected and submitted to the laboratory for each matrix, analytical group, and concentration level. QC samples will be collected and/or submitted as follows:

- At a minimum, one FD sample will be collected for every 10 or fewer primary samples, for each matrix sampled and for each target analyte. A minimum of one FD will be collected per day if 10 or more samples are collected. FDs will be collected from locations of suspected contamination at the same time and location as the primary sample and will be submitted to the laboratory blind with unique sample identification numbers.
- MS/MSD samples will be collected and submitted at a frequency of one set for every preparatory batch of 20 or fewer primary samples (5%).
- One trip blank will accompany each cooler that contains BTEX samples.
- Equipment blank samples will be collected from porewater monitoring equipment at a frequency of one for every 20 or fewer porewater samples (5%). One equipment blank will be collected and analyzed for the same analytical methods as the other porewater samples collected at the site.
- No QC samples will be collected for waste characterization samples.

Field and QC sample quantities will be based on actual quantities and determined in the field. Analytical methods and estimated sample quantities are included in Table 18-1.

WORKSHEET 21 – FIELD STANDARD OPERATING PROCEDURES

Field SOPs

SOPs applicable to this project are outlined in Table 21-1. Field SOPs are provided in Appendix B.

Table 21-1 Field Standard Operating Procedures Reference

SOP Number	SOP Title	Description	Date Last Reviewed or Updated
BE-SOP-01	Logbook Documentation and Field Notes	Logbook, field forms, camera, permanent ink pen	No
BE-SOP-02	Sample Chain-of-Custody	Field documents	No
BE-SOP-03	Labeling, Packaging and Shipping Samples	Samples, sample management items, field documents	No
BE-SOP-04	Quality Control Samples	Samples	No
BE-SOP-06	Soil Sampling	Sampling containers, coolers, disposable spoons, PPE	No
BE-SOP-09	Groundwater Sample Collection	Oil/Water interface probe, bladder pump, tubing, sampling containers, PPE	No
BE-SOP-14	Equipment Decontamination	Scrub brushes, 55-gallon drums, PPE	No
BE-SOP-15	Field Screening with PID	PID, isobutylene calibration gas, PPE	No
BE-SOP-20	Water Quality Measurements	YSI instrument, turbidity meter, calibration standards	No
BE-SOP-21	Groundwater and LNAPL Measurements	Water level indicator, PPE	No
BE-SOP-22	Monitoring Well Installation and Development	Drill rig, monitoring well, peristaltic pump, tubing, PPE	No

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

WORKSHEET 22 – FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

Field equipment will be calibrated each day prior to use, or more frequently, as needed. Any instrument "drift" from prior calibration will be recorded in a field notebook. Calibration will be conducted in accordance with the procedures included in Table 22-1. Calibrated equipment will be uniquely identified using the manufacturer's serial number. Calibration results will be recorded on field calibration logs.

Field personnel are responsible for employing properly functioning equipment. If equipment malfunction is suspected, lock-out tag-out procedures will be initiated: the device shall be removed from service, tagged so that it is not inadvertently used, and the appropriate personnel should be notified so that a recalibration can be performed, or substitute equipment can be obtained.

Table 22-1 identifies the field equipment requiring calibration, maintenance, testing, or inspection and provides the SOP number for each equipment type. In addition, this table documents calibration frequency, acceptance criteria, and corrective action requirements. Field SOPs are provided in Appendix C.

Table 22-1 Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Activity	SOP Reference	Frequency	Acceptance Criteria	Corrective Action
PID	Calibration using isobutylene gas	BE-SOP-15	Calibrate daily prior to use, and as needed	±5%	Recalibrate as necessary. If acceptable calibration cannot be obtained, return equipment to vendor for repair or replacement.
YSI	Calibration using applicable solutions (pH, conductivity, oxidation reduction potential)	BE-SOP-20	Calibrate daily prior to use, and as needed	See BE-SOP-20	Recalibrate as necessary. If acceptable calibration cannot be obtained, return equipment to vendor for repair or replacement.
Turbidity Meter	Bump test using known standards	BE-SOP-20	Check daily prior to use	See BE-SOP-20	Refer to the troubleshooting sections in BE-SOP-20.

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

WORKSHEET 23 – ANALYTICAL STANDARD OPERATING PROCEDURE REFERENCES

Table 23-1 lists all SOPs for the specific sample preparation and analytical procedures that will be used for project samples. Analytical SOPs are kept on file and will be provided upon request.

Table 23-1 Analytical Standard Operating Procedure References

Organization Performing Analysis	Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Modified for Project Work (Yes/No)
SGS	712r18_DRO_RRO	DRO/RRO [Methods AK102/AK103] (revision 17, effective January 2021)	Definitive	Porewater, Soil; DRO, RRO	GC/FID	N
	727r13_PAH	PAHs by GC/MS-SIM [Method 8270D-SIM] (Revision 13, effective September 2021)	Definitive	Porewater, Soil; PAHs	GC/MS	N
	783r06_VMS_8260D	Purgeable Organic Compounds Analysis by GC/MS and GC/MS-SIM [Method 8260D] (revision 5, effective September 2021)	Definitive	Porewater, Soil; VOCs (BTEX)	GC/MS	N

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

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WORKSHEET 24 – ANALYTICAL INSTRUMENT CALIBRATION

To ensure that the analytical methods and the selected instrumentation meet the project requirements, each analytical instrument shall be calibrated following the procedures and frequency specified by the SOP, analytical method, and in accordance with the most current version of the QSM (DoD 2021b). Specific analytical method SOP references are provided in Worksheet 23, and the laboratory analytical SOPs available upon request.

Table 24-1 are intended to provide information regarding laboratory calibration procedures for the requested methods for the project. Instrument calibration procedures, acceptance criteria, and corrective actions for the analytical methods are provided below.

Instrument Calibration Requirements

The calibrations and QA/QC shall meet the acceptance criteria specified in Table 24-1. For calibrations, the following standards must be met:

- All results reported shall be within the calibration range. Results outside the calibration range are unsuitable for quantitative work and show only an estimate of the true concentration.
- Results shall be within the working range determined by the daily initial calibration (ICAL).
- Samples shall be diluted, if necessary, to bring analyte responses within the calibration range. Data that exceed the calibration range must be reported by the laboratory with the dilution results.
- Records of standard preparation and instrument calibration shall be maintained. Records shall unambiguously trace the preparation of standards and their use in the calibration and quantitation of sample results.
- Calibration standards shall be traceable to standard materials.

Instrument calibration shall be achieved by beginning with the simplest approach (the linear model through the origin) and shall then progress through other options (nonlinear) until the acceptance criteria are met. When an analyte has more than one acceptable calibration model, results shall be reported from the simplest calibration model.

The ICAL must be verified by a second source standard. Multipoint calibrations shall contain the minimum number of calibration points specified in the applicable tables, with all points used for the calibration being contiguous. If more than the minimum number of standards is analyzed for the ICAL, all of the standards analyzed shall be included in the ICAL. The only exception is that a standard at either end of the calibration curve can be dropped from the calibration if the requirement for the minimum number of standards is met and the low point of the calibration curve is at or below the LOQ for each analyte. Analyte concentrations are determined with either calibration curves or RFs. Nonlinear calibration should be considered only when a linear approach cannot be applied. It is not acceptable to use an alternative calibration procedure when a compound fails to perform in the usual manner. When multipoint

calibration is specified, the concentrations of the calibration standards shall bracket those expected in the samples.

Continuing Calibration Verification

The CCV cannot be used as the LCS. A CCV is to be performed daily before sample analysis (unless an ICAL and second source standard verification are performed immediately before sample analysis) and as required by the applicable method. In addition, the DoD QSM requires that the concentration used for the CCV sample shall be between the low calibration standard and the midpoint of the calibration range. Finally, the lowest standard used must be the lowest concentration for which quantitative data are to be reported.

Analytical Instrument Calibration Procedures

Laboratory calibration procedures and corrective actions for the analytical methods planned for this project are included in the analytical laboratory SOPs kept on file and provided upon request. In accordance with the UFP-QAPP Optimized Worksheets guidance, Table 24-1 references the laboratory SOPs and identifies the responsible person(s).

Table 24-1 Analytical Instrument Calibration Table – SGS North America

Instrument	Person Responsible for CA	SOP Reference
GC/FID	Laboratory Analyst Laboratory QA Manager	712r18_DRO_RRO
GC/MS	Laboratory Analyst Laboratory QA Manager	727r13_PAH
GC/MS	Laboratory analyst Laboratory QA Manager	783r06_VMS_8260D

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

WORKSHEET 25 – ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION

The selected laboratory for the project, SGS Alaska, operates under a quality system that conforms to International Organization for Standardization (ISO) 17025:2017, and the 2009 The NELAC Institute (TNI) Environmental Testing Laboratory Standard, and the requirements of the DoD ELAP as detailed in version 5.4 of the DoD/DOE Quality System Manual for Environmental Laboratories (QSM), (#2944-01, DoD 2021b). SGS is also holds current ADEC Contaminated Sites Laboratory Approval (17-021), effective through January 31, 2024. The analytical instrument calibration, maintenance, testing, and inspection activities to be included in this Worksheet are documented in the laboratory Quality Assurance Manuals and SOPs. The laboratory certifications are included in Appendix C and the analytical SOPs and laboratory Quality Assurance Manuals are kept on file and will be provided upon request.

Table 25-1 Analytical Instrument Maintenance, Testing, and Inspection – SGS, Anchorage, AK

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GC-FID	Change gas line dryers as needed Replace injection port liner weekly or as needed Clip column Replace GC column as needed Check that gas supply is sufficient and delivery pressure is adequate Bake out lines and column	AK102/103	Check connections, bake out instrument, leak test	See SOP for AK102/103	Inspect system, correct problem, rerun calibration and affected samples	Inspect system, correct problem, rerun calibration and affected samples	Analyst	712r18

Table 25-1 Analytical Instrument Maintenance, Testing, and Inspection – SGS, Anchorage, AK

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GC/MS	Replace pump oil as needed Change gas line dryers as needed Perform ion source cleaning and filament replacement Replace injection port liner weekly or as needed Clip column Replace GC column as needed Manual tuning Replace electron multiplier Check that gas supply is sufficient and delivery pressure is adequate Bake out lines and column	VOCs (BTEX), PAH-SIM	Check connections, bake out instrument, leak test	See SOPs for VOCS, PAH SIM	Inspect system, correct problem, rerun calibration and affected samples	Inspect system, correct problem, rerun calibration and affected samples	Analyst	783r06, 727r13

Notes: For definitions, refer to the Acronyms and Abbreviations section.

[1] SOPs are reviewed/revised on an annual schedule. The current version will be followed at the time of sample receipt.

WORKSHEET 26/27 – SAMPLE HANDLING, CUSTODY, AND DISPOSAL

Table 26-1 lists personnel that are primarily responsible for ensuring proper handling, custody, and storage of field samples from the time of collection to laboratory delivery, to final sample disposal. This table also lists their organizational affiliations and describes the procedures and forms that will be used to maintain sample custody and integrity including CoC forms, traffic reports, sample ID, custody seals, laboratory sample receipt forms, and laboratory sample transfer forms.

Sampling Organization: Brice
Laboratory: SGS North America, Inc.
200 W Potter Drive,
Anchorage, AK 99518
Phone: (907) 550-3205
Method of sample delivery: Alaska Air Cargo and Hand Delivery

Number of days from reporting until sample disposal: In accordance with laboratory QA procedures

Table 26-1 Sample Management

Activity	Organization and Person Responsible for Activity	Reference
Sample documentation and labeling	Brice Field Manager	Worksheet 26/27 BE-SOP-01 BE-SOP-02 BE-SOP-03
Sampling identification	Brice Field Manager	Worksheet 26/27
Packaging and shipping coordination	Brice Field Manager	Worksheet 26/27 BE-SOP-03
CoC form completion	Brice Field Manager	BE-SOP-02
Sample receipt, inspection, and log-in	Brice Project Chemist Laboratory Project Manager	Worksheet 26/27 Worksheet 23
Sample custody and storage	Brice Project Chemist Laboratory Project Manager	Worksheet 26/27 Worksheet 23
Sample disposal	Laboratory Project Manager	Worksheet 26/27

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

Sample Collection

Sample management activities and the personnel primarily responsible for ensuring proper handling, custody, and storage of field samples from the time of collection to laboratory delivery, to final sample disposal are included in Table 26-1.

Sample Documentation and Labeling Requirements

Accurate and comprehensive recordkeeping is critical to documenting sample custody and includes CoC records. The field logbook and field forms will be the primary tools for capturing information collected during the field effort. Field forms are included in the task specific SOPs attached as Appendix B.

Daily activities, including sample collection, will be recorded in a bound field logbook with pre-numbered pages.

Each field logbook will contain the following information on the cover:

- Owner of the book
- Book number
- Project name and number
- Start date
- End date

Field notes will be entered in permanent ink. If any changes are made to the field record, the original notation will be crossed out with a single line, initialed, and dated by the person making the correction. The field logbook will contain the information required to recreate the sampling event and will be included in the RI Report. At a minimum, field logbooks will contain the following information:

- Project name and number
- Date and time of work, including daily start and stop times
- Name and location of site
- Full names and titles/roles of field personnel, including visitors
- Level of PPE
- Summary of equipment preparation procedures
- Description/sketch of work area
- Weather conditions
- Field observations
- Sample locations (including sketches when appropriate)
- Date and time of each sample collection event
- Field screening locations and results
- Sample identification number, location, matrix, and depth
- Explanation of any deviations from the field sampling SOP(s) or Work Plan/UFP-QAPP, including rational for the deviation
- Photograph information (e.g., time, date, location, direction, description)

Enough information will be recorded throughout collection, transport, and analysis of samples to support creation of a sample summary sheet per MED requirements (USACE 2017). This document will identify all the samples collected during the sampling event and identify the cooler used to ship each sample to the laboratory. The following minimum data will be provided in the sample summary sheet:

- Location ID
- Sample depth
- Sample ID
- Date/Time sample collected
- Analytical methods
- Matrix
- Container type/volume
- NPDL number (TBD)
- QC (e.g., TB, EB, QC, MS/MSD)
- Laboratory
- SDG number
- Field preservation
- Cooler name
- Sampler initials
- Turnaround time

Sample Identification

Samples will be given a unique identifier reflecting the sample year, location, and depth. Sample containers will be labeled to match the CoC records. At the time of sampling, appropriate sample numbers and tare weights (for VOC samples) will be recorded in the field logbook and/or field forms. Samples collected for this project will be numbered with unique identifiers as described below:

- Two-digit code for the sampling year (“22” for 2022).
- Three-digit code for the project site (“SAV” for Savoonga FSA).
- Two-digit code for the sample location description (-SW for sidewall, -B for Base and -WP for temporary well point).
- For temporary well point samples, the next two-digit number will identify the incremental number of the temporary well point (WP01, WP02).
- For soil samples, the next three digits will include a two-digit number that identifies the incremental number of the sample location (-SW01, -SW02).
- For soil samples, the last digits will include the depth (e.g., 2 for 2.0 feet bgs, 4 for 4.0 feet bgs).

Field QC samples will be identified as follows:

- The field duplicate sample for porewater samples will be assigned a 9 at the end of the primary sample identification number (i.e., 22SAV-WP01 and 22SAV-WP019).
- Trip blanks will be identified consecutively, 22SAV-TB01, 22SAV-TB02, etc.
- The equipment blank will be identified as follows: 22SAV-EB01.

Location identifiers (location IDs) are used to identify the sample location and will be included along with the sample ID on the CoC form(s). Location IDs will include the project site and sample location description and incremental number (SAV-SW101, SAV-WP01). Location IDs for trip blanks and equipment blanks will be designated on the CoC and will be the same as the sample ID (22SAV-TB01, 22SAV-TB02, etc.). Field duplicates will have the same sample ID as the primary sample.

Proposed sample IDs for each site, location, and sample type are included in Worksheet 18 Examples of sample IDs and corresponding location IDs are provided in Table 26-2.

Table 26-2 Examples of Sample IDs and Corresponding Location IDs

Sample Description	Sample Type	Sample ID	Location ID
Primary supra-permafrost porewater sample from WP-01	Primary	22SAV-WP01	SAV-WP101
Duplicate supra-permafrost porewater sample from WP-01	Duplicate	22SAV -WP019	SAV-WP101
Primary soil sample from excavation base at a depth of 8 feet bgs	Primary	22SAV-B01-8	SAV-B01
Duplicate soil sample from excavation base at a depth of 8 feet bgs	Duplicate	22SAV-B019-8	SAV-B01
Primary soil sample from excavation sidewall at a depth of 4 feet bgs	Primary	22SAV-SW01-4	SAV-SW01
Duplicate soil sample from excavation sidewall at a depth of 4 feet bgs	Duplicate	22SAV-SW019-4	SAV-SW01

Chain-of-Custody Form Completion

The CoC form tracks sample possession and handling from the time of collection through analysis and final disposition. Collected samples will remain in the custody of the field team that collected the samples until shipment to the analytical laboratory. Each CoC form will contain the information listed below:

- Unique Sample identification number (i.e., 2022SAV01)
- The first four digits define the sampling year (2022)
- The next characters define the project site Savoonga FSA (SAV)
- The next two digits represent the sequential CoC number (01, 02, 03)
- The cooler will be given a unique identification name or number, which will be recorded on the CoC form.
- The CoC form will include the sample ID, location ID, sample date/time, sampler initials, container (quantity, type, and volume), preservation method, matrix, analytical group, QC (MS/MSD, if applicable), turnaround time, NPDL Work Order Number, and any notes associated with the sample. This information will be entered for each sample collected for laboratory analysis.
- The CoC form will be signed by the person transferring custody at any stage of shipment.

A separate CoC form will be completed for each cooler. The CoC form will be placed in a plastic bag and taped to the inside lid of the cooler.

Packaging and Shipment

Samples will be stored and packaged in accordance with the following procedures:

- Store primary samples, QC samples, temperature blanks, and trip blanks together in a cooler or refrigerator until ready for packaging.
- Check that all lids are on tight.
- Match printed labels to information on jar lids, wipe off condensation, and apply labels. Labels should contain the following information at a minimum: project name or number, sample date and time, sample ID, analyses, and preservation method, if applicable.
  *Note: additional labels are **not** added to pre-tared volatile jars*.
- Package jars individually in bubble wrap, using bags or adhesive strips to secure the bubble wrap around the jars.
- Place absorbent pad and cushioning material in the bottom of the cooler.
- Stack samples, temperature blank, and trip blank, and ten to twelve frozen gel packs inside each cooler, taking care to pack samples securely upright.
- Fill excess space with bubble wrap or packing material.
- Place the CoC form in a plastic bag and tape it to the inside of the cooler lid.
- Sign and date the custody seals. Attach the custody seals on both the front and back of the cooler.
- Secure the cooler lid using strapping tape at a minimum of two locations. Attach appropriate stickers to the cooler (e.g., address labels, up arrows, fragile, chill, excepted quantities).
- Ship the cooler to the laboratory overnight via air cargo. If samples are transferred to another laboratory, they will be stored, packaged, and shipped following established CoC procedures.
- Once samples are received, the laboratory will follow Sample Custody and Storage Procedures in accordance with their SOPs.

Coolers containing soil samples with methanol preservative must not exceed 500 mL (20 soil samples with 25 mL of methanol preservative added to each 4-oz jar) for the cooler to qualify as an “Excepted Quantity” for shipping. After packaging procedures are complete, label the cooler with the official Department of Transportation candy striped “Excepted Quantities” sticker and the number “3” for UN shipping class 1230 requirements.

Sample Receipt, Inspection, and Login Procedures

A sample custodian at the laboratory will accept custody of the shipped samples, and check them for discrepancies, proper preservation, integrity, etc. The laboratory will complete a cooler receipt form when samples are received. Cooler receipt information, including the signed CoC, custody seals, and the completed cooler receipt form will be provided to the Contractor Project Chemist and emailed to receipt.cooler@usace.army.mil with 24 hours of cooler receipt. Discrepancies or other data quality issues identified by the laboratory will be forwarded to the laboratory Project Manager and/or the Contractor Project Chemist for corrective action.

Sample Custody and Storage Procedures

The laboratory sample custodian will relinquish custody of the samples to the appropriate department for analysis. Laboratory QA procedures will be followed to ensure CoC when samples are removed from their storage location for preparation and/or analysis. Following sample analysis, laboratory QA/QC checks will be completed, and the final laboratory report will be issued. Unused portions of samples will be stored in accordance with laboratory QA procedures until disposal. Unless otherwise specified, samples will be disposed of in accordance with laboratory QA procedures and federal, state, and local requirements.

Sample Disposal

Unless otherwise specified, samples will be disposed of in accordance with laboratory QA procedures and federal, state, and local requirements.

WORKSHEET 28 – ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION

The purpose of the laboratory QC sample activities is to produce data of known quality that satisfy the project-specific DQOs. This worksheet provides additional discussions relevant to the analytical QC requirements that laboratories producing definitive data will be required to follow. Table 28-1 provides documentation for corrective actions, flagging criteria, and expectations for analytical services.

Analytical Quality Control Samples

The following sections describe the analytical QC samples that will be prepared and analyzed by the laboratory for this project. The following sections describe the analytical QC samples that will be prepared and analyzed by the laboratory for this project.

Method Blank

A MB is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The MB is carried through the complete sample preparation and analytical procedure and is used to assess possible contamination resulting from the analytical process.

A MB shall be included in every analytical batch. The presence of analytes in a MB above the DL indicates the need for further assessment of the data. The source of contamination should be investigated; and measures must be taken to correct, minimize, or eliminate the problem if the concentration exceeds one-half the LOQ. For common laboratory contaminants (e.g., methylene chloride, acetone, or phthalates), the MB concentration must not exceed the LOQ (or if greater than the LOQ, less than one-tenth of the higher of the amount measured in any sample or the regulatory limit). No analytical data shall be corrected for the presence of analytes in blanks.

If an analyte is detected in the MB and at similar concentrations in the associated samples, and corrective actions are not performed or are ineffective, an appropriate flag shall be applied to the sample results.

Laboratory Control Sample

An LCS is a sample of known composition that is spiked with all target analytes. The LCS is used with each analytical batch to determine whether the method is in control. Each analyte in the LCS shall be spiked at a level less than or equal to the midpoint of the calibration curve, which is defined as the median point of the curve instead of the middle of the range. The LCS shall be carried through the complete sample preparation and analysis procedure. The LCS cannot be used as the CCV.

At least one LCS shall be included in every analytical batch. If more than one LCS is analyzed in an analytical batch, results from all LCSs shall be reported. Alaska methods AK102 and AK103 require that an LCSD is prepared and analyzed with each analytical batch. A failure of an analyte in any of the LCSs shall require appropriate corrective action, including qualification of the failed analyte in all of the samples, as required.

Laboratory Control Sample Control Limits

The LCS limits specified in the DoD QSM v.5.4 Appendix C (DoD 2021b) tables shall be used unless the analytes are not listed in these tables (in which case laboratory historical control limits [CLs] will be used). The performance of the LCS is evaluated against the QC acceptance limits. Whenever an analyte in the

LCS is outside the acceptance limit, corrective action shall be performed. If an analyte in the LCS exceeds the upper or lower CL and no corrective action is performed or the corrective action is ineffective, an appropriate flag shall be applied to all affected results.

Marginal Exceedance

A marginal exceedance (ME) is defined as one beyond the LCS CLs but within the ME limits, which are set at four standard deviations around the mean. MEs must be sporadic (random). If the same analyte exceeds the LCS CLs repeatedly (e.g., two out of three consecutive LCSs), this indicates that the problem is systematic, not random. The source of error should be located, and appropriate corrective actions should be taken.

Sporadic MEs are allowed for those analytes outside the three standard deviation CLs but within four standard deviations. MEs are not allowed for target analytes (i.e., COCs or COPCs) without specific project approval.

Matrix Spike/Matrix Spike Duplicate

An MS or MSD is an aliquot of sample collected in the field and spiked with known concentrations of all target analytes. The spiking occurs before sample preparation and analysis. Each analyte in the MS and MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for that analyte. The MS/MSD is used to document potential matrix effects associated with a site and will not be used to control the analytical process. The MS/MSD results and any associated flags will not be related to other samples that are collected from the same site where the MS/MSD set was collected, aside from the primary sample and FD (if collected at the same location). Additional volume will be collected for samples selected for MS/MSDs, and the laboratory will use those samples to prepare the appropriate MS/MSDs.

The performance of the MS and MSD is evaluated against the QC acceptance limits outlined in the DoD QSM. In general, criteria for the MS and MSD are the same acceptance criteria used for LCS limits. If either the MS or the MSD is outside the QC acceptance limits, the data shall be evaluated to determine whether there is a matrix effect or analytical error, and an appropriate flag will be applied to the affected analytes.

If the sample concentration exceeds the spike concentration, the data shall be reported unflagged. The laboratory should communicate potential matrix difficulties to the project chemist so that an evaluation can be made with respect to project DQOs.

Surrogates

Surrogates are compounds similar to the target analytes in chemical composition and behavior but not normally found in environmental samples. Surrogates are used to evaluate accuracy, method performance, and extraction efficiency. Surrogates shall be added to environmental samples, controls, and blanks in accordance with the method requirements.

Surrogate recovery limits are listed in the DoD QSM Appendix C tables. If these criteria are not available, the laboratory shall use its in-house statistically derived limits. If a surrogate recovery is outside the acceptance limit, corrective action must be performed. After the system problems have been resolved and system control has been reestablished, the sample should be reprepared and reanalyzed. If corrective actions are not performed or are ineffective, an appropriate flag shall be applied to the sample results.

Internal Standards

Internal standards are known amounts of standards that are added to a portion of a sample or sample extract and carried through the entire determination procedure. These standards are used as a reference for calibration and for controlling the precision and bias of the analytical method. Internal standards shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

If the internal standard recoveries are outside of the acceptance limits, corrective actions shall be performed. After the system problems have been resolved and system control has been reestablished, all samples analyzed while the system was malfunctioning shall be reanalyzed. If corrective actions are not performed or are ineffective, an appropriate flag shall be applied to the sample results.

Retention Time Windows

Retention Time (RT) windows are used in GC, IC, and high-performance liquid chromatography analysis for qualitative identification of analytes. RT windows are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in SW-846, Method 8000C. The center of the RT window is established for each analyte and surrogate using the RT of the midpoint standard of the ICAL. For non-mass spectrometry methods, these are updated daily using the absolute RT in the ICV.

If the RT is outside of the acceptance limits, corrective action shall be performed. This applies to all CCV subsequent to the ICV and to LCSs. If corrective actions are not performed or are ineffective, an appropriate flag shall be applied to the sample results.

Quality Control Checks

The following sections describe laboratory QC procedures.

Preparatory and Analytical Batch Requirements

A preparatory batch includes samples that are prepared or extracted together, including several laboratory QC samples that are prepared along with the field samples. A preparatory batch is a group of field samples (not exceeding 20 environmental samples) plus associated laboratory QC samples including MB, LCS, and method-required QC that are similar in composition (matrix); extracted or digested at the same time and with the same lot of reagents; and analyzed together as a group.

An analytical batch includes samples that are analyzed together, extends to cover samples that do not need separate extraction or digestion (e.g., VOC analysis by purge and trap). The analytical batch includes field samples, calibration check, calibration blank, and a closing blank and calibration verification; as well as method-required QC.

The identity of each preparatory and analytical batch shall be unambiguously reported with the analyses so that a reviewer can identify the laboratory QC samples and the associated environmental samples. The type of laboratory QC samples and the frequency of use of these samples are discussed in the following subsections.

Holding Time Compliance

All sample preparation and analysis shall be completed within the method-required holding times. Some methods have more than one holding time requirement (e.g., method SW8270D SIM). For methods not

requiring sample preparation, the holding time is calculated from the time of sample collection to the time of completion of all analytical runs. For methods requiring sample preparation before analysis:

- Preparation holding time is calculated from the time of sample collection to the time of completion of preparation.
- Analytical holding time is calculated from the time of completion of preparation to the time of completion of all analytical runs.

Holding times are determined on the basis of days, hours, and minutes. If the time of sample collection is not provided, the laboratory must assume the most conservative time of day. If holding times are exceeded and the analyses are performed, the results shall be flagged and identified in the data package case narrative.

Control Charts

Control charts are used to track laboratory performance over time. It is recommended that all analytes spiked into the LCS be tracked via control charts. These charts are useful for identifying trends and problems in an analytical method. The laboratory shall use these charts to establish in-house LCS CLs. Control charts shall be monitored on an ongoing basis (at least quarterly) for shifts in mean recovery, changes in standard deviation, and development of trends. A laboratory must use its in-house statistically established LCS CLs for trend analysis and may use in-house CLs as a component in estimating measurement uncertainty.

Standard Materials

Standard materials (including second source materials) used in calibration and to prepare samples shall be traceable to a National Institute of Standards and Technology, EPA, American Association of Laboratory Accreditation, or other equivalent approved source, if available.

All standard materials shall be stored in accordance with manufacturer's recommendations. Standard materials shall be tracked, stored, and replaced in accordance with laboratory QA procedures outlined in its QAM and appropriate SOPs.

A second source standard is used to independently confirm the ICAL. The use of a standard from a second lot obtained from the same manufacturer (independently prepared from different source materials) is acceptable for use as a second source standard. The concentration of the second source standard shall be at or near the midpoint of the calibration range.

Table 28-1 Analytical Quality Control and Corrective Action

QC Sample	Frequency/ Number	Method/ SOP QC Acceptance Limits	Corrective Action	Person(S) Responsible For Corrective Action	Measurement Performance Criteria
MB	One per preparatory batch	No analytes detected >½ LOQ or 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Verify instrument clean (evaluate calibration blank & samples prior to method blank), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then re-prepare and reanalyze the method blank and all samples processed with the contaminated blank.	Laboratory Analyst Laboratory QA Manager	No analytes detected >1/2 LOQ. Sample results will be qualified if contamination is detected above the DL in the associated MB.
LCS/LCSD	One LCS/LCSD pair per preparatory batch	AK102: Recovery 75-125% AK103: Recovery 60-120% RPD ≤20%	Reanalyze LCS/LCSD once. If acceptable, report. Otherwise, evaluate and re-prepare and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Laboratory Analyst Laboratory QA Manager	LCS/LCSD within method recovery and precision limits.
Surrogate spike	All field and QC samples	QC samples (MB/LCS/LCSD) AK102 and AK103: Recovery 60-120% Field Samples (including MS/MSD) AK101 and AK102: Recovery 50-150%	If surrogate standard is outside recovery ranges, evaluate for visible matrix interferences and reanalyze affected samples or qualify data.	Laboratory Analyst Laboratory QA Manager	Surrogate recoveries within method control limits.
MS/MSD	One pair per preparatory batch	AK102 and AK103: Use LCS Recovery Limits RPD ≤20%	Examine the project specific DQOs. Evaluate the data and re-prepare/reanalyze the native sample and MS/MSD pair as indicated.	Laboratory Analyst Laboratory QA Manager	MS/MSD recoveries within LCS method control limits. MS/MSD RPD ≤ 20% per DoD QSM.

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

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WORKSHEET 29 – PROJECT DOCUMENTS AND RECORDS

Table 29-1 identifies the documents and records that will be generated for the project. It describes how information will be collected, verified, and stored to support data completeness, data integrity, and ease of retrieval.

Table 29-1 Project Documents and Records

Record	Generation	Verification	Storage Location/Archival
Sample Collection and Field Records			
Completed Field Logbook Pages	Brice Field Sampler	Brice Field Manager	Project Files
Completed Sampling Field Forms	Brice Field Sampler	Brice Field Manager	Project Files
CoC Forms	Brice Field Sampler	Brice Field Manager, Project Chemist	Project Files
Deviations and Corrective Actions	Brice Field Sampler	Brice Field Manager	Project Files
Daily Site Safety Meeting Forms	Brice Field Manager/SSHO	Brice Project Manager	Project Files
Waste Manifests	Brice Field Manager	Brice Project Manager	Project Files
Field Change Request Form	Brice Field Manager	Brice Project Manager	Project Files
Project Assessment			
Field Audit Checklists	Brice Project Chemist	Brice Project Chemist	Project Files
Data Verification Checklists	Brice Project Chemist	Brice Project Chemist	Project Files
Data Validation Report	Brice Project Chemist	Brice Project Chemist	Project Files
Data Usability Assessment Report	Brice Project Chemist	Brice Project Chemist	Project Files
Laboratory Records			
EDDs	Subcontract laboratory	Brice Project Chemist	Project Files

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

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WORKSHEET 31/32/33 – ASSESSMENTS AND CORRECTIVE ACTION

Table 31-1 identifies the type and frequency of assessment activities that will be performed for the project. Table 31-2 describes corrective actions for assessments, and Table 31-3 lists reporting requirements. Additional reporting content is detailed in Section 6.0.

Table 31-1 Planned Project Assessments

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
Laboratory technical evaluation	Once, prior to subcontract award and before sampling begins	Internal	Brice	Brice Project Chemist	Analytical Laboratory Project Manager	Analytical Laboratory Project Manager	Brice Project Chemist
Premobilization meeting	Once, prior to project mobilization	External	Brice	Brice Field Manager	Brice Project Manager	Brice Project Manager	Brice Project Manager/Brice Field Manager
Field sampling technical evaluation	Initial and ongoing	Internal	Brice	Brice Field Sampler(s)/ Brice Field Manager	Brice Field Sampler(s)/ Brice Field Manager/ Brice Project Manager	Brice Field Sampler(s)/ Brice Field Manager	Brice Field Sampler(s)/ Brice Field Manager
Archaeological monitoring	Ongoing	External	AKARNG	AKARNG Archaeological Monitor	USACE	AKARNG Archaeological Monitor/Brice Project Manager/Brice Field Manager	AKARNG Archaeological Monitor
Analytical data review	After receipt of analytical results	Internal	Brice	Brice Project Chemist	Analytical Laboratory Project Manager	Brice Project Chemist	Brice Project Manager
Field inspection/ audit	As determined by ADEC	External	ADEC	ADEC	USACE	USACE	USACE

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

Table 31-2 Assessment Response and Corrective Action

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Premobilization meeting	Submittal register	Brice Field Manager/ Brice Project Manager	Within 24 hours or sooner, if necessary	Email or other written documentation	Brice Field Staff and Subcontractor Staff	While on site, if possible
Field sampling technical evaluation	Logbook notes, porewater sampling forms, core logs	Brice Project Manager	Within 24 hours	Logbook notes, email correspondence, or documentation in report	Brice Field Sampler(s)	While on site if possible; otherwise, document deviations in the logbook notes and/or in the report
Analytical data review	Email correspondence, CoC variance request forms, cooler receipt forms	Analytical Laboratory Project Manager	Within 24 hours	Email correspondence, formal corrective action report/letter, case narrative	Brice Project Chemist	Within holding times, if possible; otherwise, prior to reporting analytical data

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

Table 31-3 Reporting

Type of Report	Frequency	Projected Delivery Date(s)	Party Responsible for Report Preparation	Report Recipient(s) (Organizational Affiliation)
Final Report	Draft, draft final, and final versions, after completion of fieldwork and receipt of the final analytical data reports	See Worksheet 14/16	Brice	USACE, AKARNG, ADEC
Data quality review and assessment, including the ADEC Laboratory Data Review Checklist (ADEC 2020)	Once, after completion of fieldwork and receipt of the final analytical data reports	See Worksheet 14/16	Brice	USACE, ADEC

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

WORKSHEET 34 – DATA VERIFICATION AND VALIDATION INPUTS

Table 34-1 lists the inputs that will be used during data verification and validation. Inputs include planning documents, field records, and laboratory records. Data verification is a check that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records are available to proceed to data validation. Data validation includes an evaluation of conformance to stated requirements, including those in the contract, methods, SOPs, and QAPP.

Table 34-1 Data Verification and Validation Inputs

Description	Verification (Completeness)	Validation (Conformance to Specifications)
Planning Documents/Records		
Approved UFP-QAPP	X	X
Contract	X	
Field SOPs	X	
Laboratory certifications, SOPs, and reporting limits	X	X
Statement(s) of work	X	
Field Records		
Field logbook(s)	X	X
Field instrument calibration logs	X	X
CoC and cooler receipt form	X	X
Sampling diagrams/surveys	X	X
Daily quantity reports	X	X
Waste manifests and disposal records	X	X
Correspondence	X	X
Change orders/deviations	X	X
Field audit reports	X	X
Field corrective action reports	X	X
Analytical Data Package		
Case narrative	X	X
Internal laboratory CoC form(s)	X	X
Cooler receipt form(s) for each cooler of samples	X	X
Sample date/time of receipt, date/time of prep, date/time of analysis	X	X
Initial and continuing calibration	X	X
Field sample and field QC sample results	X	X
Laboratory QC sample results	X	X
DL, LOD, and LOQ reported	X	X
DL, LOD, and LOQ establishment and verification	X	X
Raw data	X	X
Benchsheets/worksheets	X	X

Table 34-1 Data Verification and Validation Inputs

Description	Verification (Completeness)	Validation (Conformance to Specifications)
Instrument analytical run logs	X	X
Instrument maintenance and operations logs	X	X
Definition of laboratory qualifiers	X	X
ERPIMS EDD compatible with most recent version of ERPTools	X	X
SEDD Version 5.2, Stage 2a	X	X
Electronic versions of the laboratory report	X	X
Communication records	X	X
Documentation of data quality issues and resolutions, including CAs	X	X

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

WORKSHEET 35 – DATA VERIFICATION PROCEDURES

Table 35-1 describes data verification procedures, including types of records, required documents, process descriptions, and responsible persons.

Table 35-1 Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field documentation including field logbook(s), GPS coordinates, and photographs	UFP-QAPP Field SOPs	Verify accuracy and completeness for each day of field activities. Verify that all planned samples, including field QC samples, were collected and documented in accordance with the Field SOPs and QAPP requirements. Verify that deviations from planned activities were documented. Verify that field monitoring and field measurements were recorded.	Brice Lead Sampler
Field SOPs	UFP-QAPP Field SOPs	Verify that the sampling SOPs were followed.	Brice Lead Sampler
Analytical SOPs	UFP-QAPP	Verify that the analytical SOPs were followed.	Laboratory QA Manager and Subcontract Laboratory
Sample receipt documentation (CoC forms, cooler receipt forms, laboratory log-in information)	UFP-QAPP Field SOPs	Examine CoC forms against project requirements (correct analytical methods requested, samples identified correctly, complete CoC). Verify CoC (CoC relinquished, samples received). Verify accuracy and completeness. Verify that discrepancies were documented and resolution of any potential data quality issues.	Brice Project Chemist, Brice Lead Sampler, and Brice Field Sampler(s)
Sample summary table(s)	UFP-QAPP	Verify sample summary sheet generated in accordance with the USACE Alaska District Manual for Electronic Deliverables. Verify accuracy and completeness of the sample summary by comparing against the planned samples and the CoCs and cooler receipt forms for samples submitted to the laboratory.	Brice Lead Sampler Brice Project Chemist
Field measurements, including field screening results	UFP-QAPP Field SOPs	Verify that field measurements meet the QA/QC requirements established in the project QAPP. Verify accuracy and completeness.	Brice Lead Sampler

Table 35-1 Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Laboratory data packages	UFP-QAPP	Verify accuracy and completeness of the laboratory data packages: ES.1 Verify that laboratory procedures used to generate the analytical data were performed in accordance with the DoD QSM. ES.2 Verify that data for all samples submitted to the laboratory (based on the sample summary) have been provided. ES.3 Verify that the complete copy of the laboratory report includes all relevant laboratory QC data (including raw data) and is provided in searchable PDF format. Verify that the specified analytical and extraction methods were performed by the laboratories.	Brice Project Chemist
EDDs	UFP-QAPP	Verify that EDDs meet contract requirements. Verify that the EDDs are consistent with the hardcopy data package. Verify that the SEDD 5.2, Stage 2a is error-free, matches the hardcopy data package, and is compliant with the USACE Alaska District MED (USACE 2017).	Laboratory QA Manager Brice Project Chemist
Analytical results, including DL/LOD/LOQ, and laboratory data qualifiers	Work Plan CoC Forms	Verify that the specified analytical methods were used by the laboratory. Verify that data for all samples submitted to the laboratory have been provided. Verify that reporting limits meet DQOs specified in the QAPP. Verify that method and required QC samples were analyzed, and all relevant data (including chromatograms) have been provided. Verify that soil sample results are dry-weight corrected. Ensure that required lists of analytes were reported as specified.	Laboratory QA Manager and Brice Project Chemist
Field QC sample results	UFP-QAPP	Verify that all QAPP-required QC samples were collected and analyzed.	Brice Lead Sampler, and Brice Project Chemist
Audit reports, CA reports	UFP-QAPP	Verify accuracy and completeness. Verify that CAs were documented and implemented.	Laboratory QA Manager, Subcontract Laboratory, and Brice Project Chemist

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

WORKSHEET 36 – DATA VALIDATION PROCEDURES

The data quality review process consists of data verification, data validation, and data usability assessment. Data verification confirms that the specified requirements have been performed. Data verification and validation inputs are included in Worksheet 34, and data verification procedures are included in Worksheet 35.

Data validation is the systematic process of evaluating whether the data comply with the predefined requirements of the project (including method, procedural, and contractual requirements) and comparing the data with criteria based on the DQOs documented in this UFP-QAPP. This worksheet documents procedures that will be used to validate project data. The validation process is summarized in Table 36-1.

Table 36-1 Data Validation Procedures to be Performed

PROCEDURES	DESCRIPTION
Analytical Group/Method	All methods analyzed by the analytical laboratory.
Data deliverable requirements	Level IV report in PDF, SEDD Version 5.2, Stage 2a (POA format)
Analytical specifications	See Worksheet 28
MPC	See Worksheet 12
Percent of data packages to be validated	100%
Percent of raw data reviewed	Varies: Raw data may be reviewed when matrix interference is suspected, or discrepancies are identified by the laboratory.
Percent of results to be recalculated	0%
Chemical data quality review procedures	Worksheet 36
Level of data quality review	S2bVEM[1]

Notes:

[1] Stage 2B Validation Electronic and Manual. Chemical data quality review will be consistent with the Stage 2B electronic procedures outlined in Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, EPA 540-R-08-005 (EPA 2009).

All types of data, including screening data and definitive data, are relevant to the data validation and usability assessment. The following subsections focus on the data review requirements for definitive data only.

Laboratory Reporting Requirements

Laboratories used to perform work for this project are required to follow the appropriate program and method requirements to ensure that the data quality is acceptable and can be used to support project decisions.

Laboratory certification requirements include the following:

- Current State of Alaska certificate of approval for Contaminated Sites analysis
- DoD ELAP approval for the fields of testing and matrices proposed on the project

Analytical Data Package Requirements

A group of samples submitted to the laboratory at the same time and included on the same CoC will be considered an SDG. The results for an SDG will be reported as one analytical data package. Laboratories must provide Level IV data packages that meet the minimum requirements included in the ADEC Data Quality Objectives, Checklists, Quality Assurance Requirements for Laboratory Data, and Sample Handling Technical Memorandum (ADEC 2017d) and the DoD QSM Version 5.4 (DoD 2021b).

Laboratory analytical reports must meet the following minimum requirements:

- Case narrative must meet ADEC requirements and shall include the project name and USACE NPDL work order number (22-XXX)
- Project name
- Field sample ID number on CoC
- Abbreviated subcontracted laboratory name
- Subcontracted laboratory report number
- Lab ID number for sample
- Date sample collected
- Date sample received at subcontracted laboratory
- Date sample extracted, prepared, and analyzed
- Extraction or preparation procedures, if appropriate
- Analysis procedure including method numbers
- Analyte of parameter
- DL/LOD/LOQ for all results
- Initial and continuing calibration
- Analytical results and units
- Dilution factor
- Chromatograms for all methods
- Matrix
- Sample description (e.g., multi-phase, non-homogeneous, pebbles, roots, cloudy, viscous)
- Soil/sludge and solid waste data shall be reported on a dry-weight basis with percent moisture included
- Original CoC record, custody seals, and sample cooler receipt forms, with all forms properly signed and dated

Laboratory Data Reporting Requirements

At minimum, laboratory data deliverables for each SDG will include the following:

- Searchable and bookmarked electronic Level IV data package in PDF for each SDG consistent with the requirements specified in ADEC *Data Quality Objectives, Checklists, Quality Assurance Requirements for Laboratory Data, and Sample Handling Technical Memorandum* (ADEC 2017d) and the DoD QSM.
- SEDD, Version 5.2, Stage 2a, compliant with the MED (USACE 2017) and the POA instructional set.

The following result reporting requirements will be met for laboratory data:

- DLs and sample results should be reported to one decimal place more than the corresponding LOQ, unless the appropriate number of significant figures for the measurement dictates otherwise.
- Results for soil and sediment samples will be reported on a dry-weight basis. DLs, LODs, and LOQs will be adjusted for moisture.
- Samples should be analyzed undiluted, if possible. ND results will be reported to the LOD.

All reported data shall reflect any dilutions and/or concentrations. The dilution factor, if applicable, shall be noted on the analytical report. Such changes should also be reflected in the reporting limits with footnotes detailing the reason for the dilution. If dilution is required, data from both runs shall be recorded and reported; however, one result will be selected and reported as the primary result. If samples must be rerun for any reason, the data shall be included in the report. Chemical data results between the DL and the LOQ will be flagged "J."

Laboratory Data Evaluation

All analytical data that the laboratory generates shall be verified before submittal to the project team. This internal data review process shall include all aspects of data generation, reduction, and QC assessment.

The calibration, QC, CAs, and flagging requirements for definitive data are included in Worksheet 24 and Worksheet 28 The laboratory shall apply data qualifiers as part of its internal validation activities. The allowable data qualifiers for definitive data are defined in the DoD QSM. Flagging criteria apply when acceptance criteria are not met and when CAs are not successful or not performed.

The project chemist or data validator will subsequently evaluate the flags that the laboratory applied as part of its data validation and usability assessment activities. The flags may be accepted, modified, or rejected. For all data qualifiers that are changed, clear justification must be provided.

Data Validation Procedures

All project data will be reviewed on an analytical-batch basis by assessing QC samples and associated field sample results. Data quality review and assessment will be performed using the QC criteria defined in this UFP-QAPP; the DoD QSM Version 5.4 (DoD 2021b); *Data Validation Guidelines Module 1: Data Validation Procedure for Organic Analysis by GC/MS* (DoD 2020); *Data Validation Guidelines Module 4: Data Validation Procedure for Organic Analysis by GC* (DoD 2021a); ADEC *Data Quality Objectives, Checklists, Quality Assurance Requirements for Laboratory Data, and Sample Handling Technical Memorandum*

(ADEC 2017d); specific method guidance, such as the ADEC *Underground Storage Tanks Procedures Manual, Guidance for Treatment of Petroleum-Contaminated Soil and Water and Standard Sampling Procedures* (ADEC 2017c) and *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium* (SW-846), *Update V* (EPA 2014); and the laboratory SOPs, in that order.

Data quality review and assessment is typically performed by person(s) independent of the activity being evaluated. Data quality review includes completing the ADEC Laboratory Data Review Checklist (ADEC 2020) for each SDG, the review of the analytical data including QC sample results, field and laboratory QA reports, and all data submittals.

The following information will be reviewed during the data quality review and assessment:

- CoC documentation
- Holding time compliance
- QC sample frequencies
- Blanks
- LCS recoveries (and precision, if LCSD performed)
- Surrogate spike recoveries
- MS/MSD recoveries and precision
- Initial and continuing calibration summary information
- Internal Standards
- Field duplicate precision
- Case narrative review, laboratory flagging review, and other method-specific criteria.

In general, EDDs will be evaluated for consistency with project and contract requirements. EDDs will be consistent with the Level IV .pdf report.

Data Validation Guidelines

The chemical data quality review will identify results requiring qualification and potential effects on data usability based on the MPC in Worksheet 12 and Worksheet 28. Table 36-2 defines the qualifiers to be applied to the analytical data set, as appropriate. Direction of bias will be indicated wherever possible.

Table 36-2 Validation and Usability Assessment Data Qualifiers

Qualifier	Description
J	Analyte is considered an estimated value because the result is greater than or equal to the DL and less than the LOQ.
B	Analyte result is considered a high estimated value due to contamination present in the method, trip blank, or equipment blank.
H	Analyte result is considered an estimated value, biased low, due to holding time exceedance.
QH/QL/QN	Analyte result is considered an estimated value biased (high, low, uncertain) due to a QC failure.
X	Analyte result is under review for rejection – result may not be usable. Note that "R" replaces the chemical result (no result shall be reported with an "R" flag) if the results are rejected.

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

In some cases, more than one qualifier may apply to a result. Final validation qualifiers will be assigned based on the following hierarchy, from most severe to least severe: X/R, QL, QH, QN, H, and B. When the result is not detected, only the most severe flag is presented; but when a result is estimated below the LOQ, the most severe flag is added to the J-flag.

Qualification will not be required in the following circumstances:

- Surrogate or MS recoveries were outside QC limits, and the sample was diluted by a factor of 5 or greater.
- MS recoveries were outside QC limits, and the spiked concentration was less than 4 times that of the parent sample.
- An analyte was detected in the MB, but there was no detection in the sample.
- MS/MSD or LCS/LCSD recoveries exceeded upper control limits (UCLs), and there was no detection in the sample(s).

Data may be considered for rejection on the following grounds:

- ICAL (per compound) criteria not met.
- Continuing calibration (per compound) not verified.
- All NDs with the continuing calibration recovery less than CLs.
- All NDs with the LCS recovery less than CLs.
- Any compound with LCS recovery less than 10%.
- Missed holding times greater than two times the method-specified holding time.
- Surrogate recovery of less than 10% and a dilution factor of 5 or less.

Blank Evaluation Guidance

The Brice project chemist will evaluate MBs, as well as other field blanks, based on the concentration of the analyte in the samples in relation to the concentration in the blank. The Brice project chemist must discuss any blank contamination that may affect data usability in conjunction with project-specific goals.

When a data set contains low-level detects in field samples and has associated field or laboratory blanks that have detects at similar concentrations, this suggests that the low-level detects in these field samples may be artifacts because of either field or laboratory practices. MBs will be evaluated to the DL. If an analyte is detected in the MB above the DL, associated sample results that are less than or equal to 10 times the amount found in the MB will be flagged "B" at the detected concentration to document the associated blank contamination.

Duplicate Evaluation Guidance

QC measures for precision include FDs, laboratory duplicates, and MSDs. The laboratory will evaluate and qualify these measures according to procedures outlined in Worksheet 28, except for the FDs.

To evaluate FD precision, the RPD between duplicate results will be calculated. Duplicate results will be qualified "QN" if the RPD exceeds the recommended 50% for soil and 30% for water (Worksheet 12). Duplicate results will be qualified when both results are detected above the DL. When one result is detected and one result is ND, the RPD will not be calculated and both results will be qualified.

FD results can be used to assess field sampling precision, laboratory precision, and, potentially, the representativeness of the matrix sampled. Poor overall precision may result from one or more of the following:

- Field instrument variation
- Analytical measurement variation
- Poor sampling technique
- Sample transport problems
- Spatial variation (heterogeneous sample matrices)

To identify the cause of imprecision, the project team should evaluate the field sampling design rationale and sampling techniques, as well as review both field and analytical duplicate sample results. If poor precision is indicated in both the field and analytical duplicates, then the laboratory may be the source of error. If poor precision is limited to the FD results, then the sampling technique, field instrument variation, sample transport, and/or spatial variability may be the source of error. If data validation reports indicate that analytical imprecision exists for a particular data set or SDG, then the reports must discuss the effect of that imprecision on usability.

Chemical Data Quality Report

The data review will include preparation of a chemical data quality report, as well as the completion of an ADEC Laboratory Data Review Checklist (ADEC 2020) for each laboratory data package.

The chemical data quality report will present detailed results of the data quality review and usability assessment, including, but not limited to, a summary of PARCCS parameters; the QC samples and acceptance criteria used to evaluate each parameter; the extent of the QC exceedance; identification of samples affected by the QC exceedance; and discussion of any qualifiers applied to the sample results, including potential direction of bias and relationship to screening levels and/or cleanup levels (if possible). Significant trends and biases in the data will be evaluated and identified, as well as effects on data usability. A detailed description will be provided for any CAs and/or systematic problems that were identified during the data review process.

Analytical data will be tabulated in the completed report. All analytical results, including duplicate results, will be reported with any appropriate qualifiers in accompanying data tables. Chemical data tables will be formatted in accordance with the 2017 MED and will include the following information:

- Location ID
- Field sample ID
- Laboratory ID number
- Collected date/time
- Matrix
- Analytical method
- Analyte(s)
- Concentration units
- Result
- PAL(s)
- LOD for each sample ID/method/ analyte/matrix and
- Qualifiers.

Laboratory LODs for ND results will be compared to the project action limits established for the method/analyte/matrix in Worksheet 15. If the laboratory LOD for the ND result exceeds the PAL, the result will be flagged or otherwise highlighted. Rejected data shall be presented in a table with a brief explanation of the reason(s) for data rejection. Table 36-3 lists general data qualifying conventions.

Table 36-3 Data Qualifying Conventions Based on Quantitation of Results

Criteria	Flag
Time exceeded for extraction or analysis	QL for positive results and NDs
Time exceeded for extraction or analysis by a factor of >2	QL for positive results; X for NDs
Improper sample preservation	QL for positive results and NDs (all results for volatile soil samples not preserved in the field will be rejected)
Temperature >6 °C upon receipt	QL for positive results and NDs
Temperature >8 °C upon receipt at laboratory	QL for positive results; X for NDs
Temperature <0 °C upon receipt and not frozen or otherwise adversely affected	No flag required
Bubbles in VOA vial > 6mm used for analysis	QL for positive results and for NDs
Ion abundance method-specific criteria not met	X for all results
All analytes must be within method-specified criteria	X for all results
All analytes must be within method-specified criteria	X for all results
All analytes must be within method-specific criteria Note: closing CCV for GC/MS must be within 50%-150%	QH/QL/QN for positive results and for NDs
Criteria exceeded by more than 2x	QH/QL/QN for positive results; X for NDs
All analytes must be within 50% of expected value	High bias: QH for positive results Low bias: QL for positive results and for NDs
Criteria exceeded by more than 2x	QH/QL/QN for positive results; X for NDs
All analytes must be within 20% of expected value	High bias: QH for positive results Low bias: QL for positive results and NDs
Criteria exceeded by more than 2x	QH/QL/QN for positive results; X for NDs
Area >UCL	QL for positive results; X for NDs
Area < lower control limit (LCL)	QH for positive results
%R > UCL	QH for positive results
%R < LCL	QL for positive results and for NDs
%R <10%	QL for positive results; X for NDs
%R >UCL	QH for positive results
%R <LCL and >10%	QL for positive results and NDs
%R <10%	QL for positive results; X for NDs
Dilution >5x	No flagging required for failed surrogates
Analyte(s) detected above the DL (use the blank of the highest concentration)	B for positive sample results $\leq$ 10 times
RPD > CL and FDs > LOQ	QN for positive results
One FD > LOQ, one ND	RPD not calculated, and QN for both results
One FD>LOQ, one FD >LOD but <LOQ	QN for positive results for RPDs outside QC limits
Both results <LOQ	RPD not calculated (no flags required)
MS or MSD %R >UCL	QH for positive results
MS or MSD %R <LCL	QL for positive results and NDs
MS or MSD %R <10%	QL for positive results; X for NDs
MS/MSD RPD >CL	QN for positive results
Sample concentration > 4X spike concentration, or excessive dilution (dilution >5x)	No flag required
Analyte within established window	X for all results if analyte is outside established window

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

WORKSHEET 37 – DATA USABILITY ASSESSMENT

The data usability assessment is an evaluation based on the results of data verification and validation in the context of the overall project decisions or objectives. The assessment determines whether the project execution and resulting data meet the project DQOs. The sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

The following subsections summarize (1) the processes used to determine whether the collected data are of the right type, quality, and quantity to support project decision making; (2) how data quality issues will be addressed; and (3) how limitations of the use of the data will be handled.

The Data Usability Assessment (Table 37-1) includes specific examples of items that may be evaluated during the usability assessment, as applicable.

Summary of Usability Assessment Processes

A usability assessment is performed to determine how well the data collected for a particular project support the project objectives. Decisions can then be made by the project team (e.g., PM, project chemist).

Data gaps may be present if (1) a sample is not collected, (2) a sample is not analyzed for the requested parameters, or (3) the data are determined to be unusable. The need for further investigation will be determined on a case-by-case basis. This determination will depend on whether data can be extrapolated from adjacent sample locations and whether the data are needed based on the results from adjacent sample locations.

The project chemist and the analytical laboratory subcontractor will ensure that the collected data meet the DLs, LODs, LOQs, and laboratory QC limits specified in this UFP-QAPP, as referenced. During the data quality review, nonconformances will be documented and the project chemist will apply qualifiers in accordance with the chemical data quality review procedures in Worksheet 36. Apart from rejected data, all data are usable as qualified by the project chemist. The project chemist will then evaluate potential effects on data usability and work with the project team to determine whether the data are usable within the context of project objectives.

Personnel Responsible for Performing the Usability Assessment

The Brice project team's in-house data management team will be responsible for performing the analytical data usability assessment.

The project chemist will also perform a usability assessment of the validated data. The Brice Project Manager and Brice geologist, with support from the Brice project chemist, will use the results of the usability assessments to determine whether the data generated during the investigation can be used to answer the principal study questions.

Usability Assessment Procedures and Documentation

As described in Worksheet 36, the Brice project chemist will generate a chemical data quality report to be included with the project report that describes the results of the data verification, validation, and usability

assessment. The Brice project chemist will work with the Brice PM, Brice lead sampler, and other project staff to discuss conclusions drawn and determine any potential limitations on the usability of the project data as a result of the assessment. The data quality assessment will document all data nonconformance and usability determinations, even in cases where it is determined that the usability of the data is not affected.

The usability of the data collected during field activities will be assessed in several ways:

- Any deviations from proposed field activities and sampling and handling procedures will be reviewed and their effect on data usability evaluated.
- Field screening and analytical results for field samples and field and laboratory QC samples will be compared against the project DQOs and evaluated using the MPC in Worksheet 12.
- Analytical results, including ND values, will be compared against the PALs and laboratory-specific limits in Worksheet 15.
- Data verification and data quality review will be completed following the procedures in Worksheet 31, 32, and 33; Worksheet 34; Worksheet 35; and Worksheet 36.
- Based on the results of data verification and data quality review, the usability of the data will be evaluated in the context of project specific DQOs following the procedures in Worksheet 37.

Measurement error will be evaluated by reviewing sampling design, sampling locations, and sample collection methods. The Brice project chemist or data validator will evaluate laboratory and field QC sample results (e.g., FDs, performance evaluation samples, blanks, LCSs, surrogate recoveries, and matrix effect) to assess the overall measurement error associated with the project.

Bias Contamination

The analytical results for blanks (including MBs, trip blanks, and equipment rinsate blanks) will be checked against the MPC in Worksheet 12 to evaluate possible bias as a result of contamination.

Precision and Accuracy

Laboratory precision is measured by the variability associated with duplicate (two) or replicate (more than two) analyses. One type of sample that can be used to assess laboratory precision is the LCS. Multiple LCS analyses over the duration of the project can be used to evaluate the overall laboratory precision for the project. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch but between LCSs analyzed in multiple batches.

Precision and accuracy will be evaluated using DQIs such as FDs, MS/MSDs, LCSs, RSDs, and surrogates. Precision and accuracy of the data set will be considered acceptable after integration of qualified results (i.e., estimated [J] and ND estimated results).

Representativeness

All samples for each method and matrix will be evaluated for holding time compliance. Representativeness of the project data is evaluated by reviewing qualified results with regard to the use of standard methods and sampling procedures, sampling locations and quantities, and sampling design.

Sensitivity

Analytical methods and laboratory instrumentation are selected for use based on the ability of the method to detect target analytes at or below the PALs. The capability of analytical laboratory methods and instrumentation to provide data with the sensitivity to meet the DQOs in the project sample matrix will be evaluated as part of the usability assessment. The DLs, LODs, and LOQs will be evaluated against the PALs to determine whether the analytical methods and/or laboratory meet the project DQOs.

Comparability

Data comparability will be evaluated through the collection and analysis of FDs and field blanks. The laboratory use of standard analytical methods for their analyses and operation of instruments within their range of calibration will be reviewed. The analytical results will be reported in correct standard units. Holding times, sample preservation, and sample integrity will be evaluated for compliance with QC criteria.

Complete field documentation using standardized data collection forms shall support the assessment of comparability. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project. Assessment of comparability is primarily subjective. Experienced environmental professionals with a clear knowledge of the DQOs and project decisions should interpret the results.

Completeness

Following the data validation, a completeness check will be performed based on the MPC in Worksheet 12. Valid data are data that are usable in the context of the project goals. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set.

For completeness requirements, valid results are all results not qualified with an R-flag (Rejected) after the usability assessment has been performed. Completeness should not be determined only on the basis of laboratory data qualifiers.

Table 37-1 Data Usability Assessment

Item	Assessment Activity	Responsibility
Laboratory data deliverables and Work Plan	Ensure that all necessary information was provided, including (but not limited to) QC sample results and data validation results.	Brice Project Chemist
Sampling locations, deviation	Determine whether alterations to sampling locations continue to satisfy the project DQOs.	Brice Field Team, Brice Lead Sampler, Brice PM
CoC, deviation	Establish that any problems with documentation or custody procedures do not prevent the data from being used for the intended purpose.	Brice Project Chemist
Holding times, deviation	Determine the acceptability of data where holding times were exceeded.	Brice Project Chemist
SOPs and methods, deviations	Evaluate the impact of deviations from analytical and field SOPs and specified methods on data quality.	Brice Lead Sampler, Brice Field Team, Brice Project Chemist
QC samples	Evaluate the implications of unacceptable QC sample results on the data usability for the associated samples. For example, consider the effects of observed blank contamination.	Brice Project Chemist
Matrix	Evaluate matrix effects (interference or bias).	Brice Project Chemist
Meteorological data and site conditions	Evaluate the possible effects of meteorological (e.g., wind, rain, temperature) and site conditions on sample results. Review field reports to identify whether any unusual conditions were present and how the sampling plan was executed.	Brice Field Team, Brice Lead Sampler
Comparability	Ensure that results from different data collection events achieve an acceptable level of agreement.	Brice Project Chemist
Completeness	Evaluate the impact of missing information. Ensure that enough information was obtained for the data to be usable (completeness as defined in the project DQOs documented in this UFP-QAPP).	Brice PM, Brice Field Team, Brice Project Chemist
Critical samples	Establish that critical samples and critical target analytes, as defined in the UFP-QAPP, were collected and analyzed. Determine whether the results meet criteria specified in the UFP-QAPP.	Brice PM, Brice Field Team, Brice Project Chemist
Data restrictions	Describe the exact process for handling data that do not meet project DQOs (i.e., when MPC are not met). Depending on how those data will be used, specify the restrictions on use of those data for environmental decision making.	Brice PM, Brice Field Team, Brice Project Chemist
Usability decision	Determine whether the data can be used to make a specific decision considering the implications of all deviations and CAs.	Brice PM, Brice Field Team, Brice Project Chemist
Usability report	Discuss and compare overall precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity for each matrix, analytical group, and concentration level. Describe limitations on the use of project data if criteria for DQIs are not met.	Brice Project Chemist

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

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FIGURES

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1 INCH



WORK PLAN/UFP-QAPP REMEDIAL ACTION
NATIONAL GUARD FEDERAL SCOUT ARMORY
SAVOONGA, ALASKA

LOCATION AND SITE VICINITY

DATE: 6/22/2022

PROJECT No.: 550501

DRAWN: J.C.

FIGURE: 1

Document Path: \\ad.billsta.net\brice\Anchorage\Environmental\Shared\BEL\5 PROJECTS\D oD\USACE AK SB HTRW\5505_AKARNG_GAM.SAV.NOA\10 - Submittals\SAV_QAPP\Final_Supplemental_GIS\1_MXD\SAV_WP_QAPP\01_Location_and_Site Vicinity.mxd

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1 INCH



WORK PLAN/UFP-QAPP REMEDIAL ACTION NATIONAL GUARD FEDERAL SCOUT ARMORY

SAVOONGA, ALASKA

SITE FEATURES

Notes:

1. Locaiton of water line is approximate.

References:

1. Map produced using ESRI ArcMap v. 10.5.
2. Image provided by Digiglobe, 07/11/2014.
3. Map produced using ESRI ArcMap v. 10.5.

ALASKA STATE PLANE ZONE 9
HORIZONTAL DATUM: NAD83 (2011)
VERTICAL DATUM: NAVD88

350 175 0 350

SCALE IN FEET

PROJECT No.:	DATE:	FIGURE:
550501	6/22/2022	2
P.M.: MO	DRAWN: JC	

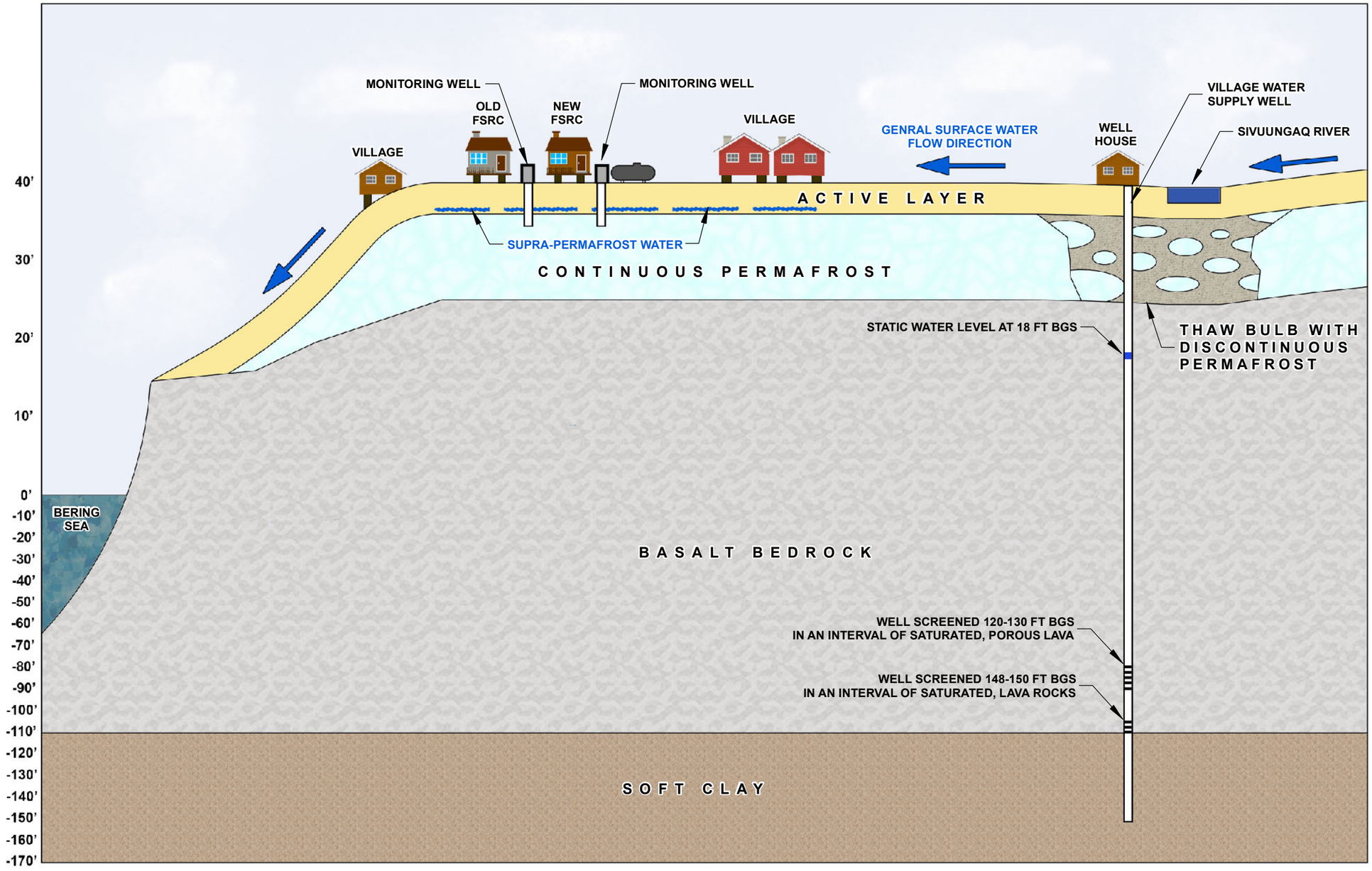
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1 INCH

WORK PLAN/UFP-QAPP
REMEDIAL ACTION
NATIONAL GUARD FEDERAL
SCOUT ARMORY
SAVOONGA, ALASKA

SAVOONGA CONCEPTUAL HYDROLOGY MODEL



Abbreviations:

ft bgs ..... feet below ground surface

Notes:

1. Map not to scale.
2. This conceptual hydrology model is based on a composite of soil borings logs, supra-permafrost water monitoring wells, and historic investigation information, which is provided in Section 7.2 of the Decision Document. Logs from the 1972 village water supply well installation and a 1966 well installation attempt provided information about regional geology and depth to bedrock.

PROJECT No.:	DATE:	FIGURE:
550501	6/22/2022	3
P.M.:	DRAWN:	
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1 INCH

WORK PLAN/UFP-QAPP REMEDIAL ACTION NATIONAL GUARD FEDERAL SCOUT ARMORY

SAVOONGA, ALASKA

PREVIOUS SOIL AND POREWATER SAMPLE LOCATIONS AND EXCEEDANCES

N

11SAVGW002
SAV-ACL-001
SV041
SAV-ACL-007
B-04
11SAVGW001
SAV-ACL-011
MW-04
11SAVSB013
B-18
11SAVSB008
SAV-ACL-012
09SAV-01-G090
09SAV-01-H100
11SAVSB009
09SAV-01-F090
B-05
11SAVSB012
09SAV-01-H105
09SAV-01-G100
B-07
11SAVSB011
MW-05
09SAV-01-G105
1,500-gallon AST
SV031
09SAV-01-G115
09SAV-01-E105
B-06
SAV-ACL-002
09SAV-01-F110
11SAVSB010
DayTank
09SAV-01-E115
11SAVSB007
09SAV-01-D115
B-08
Former 3,000-gallon AST Removed in 2002
Walkway
Old Federal Scout Readiness Center
New Federal Scout Readiness Center
MW-03
SAV-ACL-006
B-03
B-11
09SAV-02-M115
B-02
11SAVSB003
09SAV-02-K105
DayTank
09SAV-02-J105
B-10
SAV-ACL-015
Ramp
SV051
09SAV-02-I105
B-13
SAV-ACL-008
09SAV-02-H100
B-09
B-12
09SAV-02-K120
11SAVSB001
09SAV-02-H105
SAV-ACL-009
1,500-gallon AST
Former Shed
B-14
B-17
11SAVSB004
SAV-ACL-016
09SAV-02-G110
09SAV-02-H120
Former 3,000-gallon AST Removed in 1993
11SAVSB006
09SAV-02-I130
09SAV-02-G115
Former Hazardous Material Storage Locker
Former Storage Van
B-16
SV011
B-01
B-15
11SAVSB005
MW-02
1,500-gallon AST
MW-01
SAV-ACL-005
SV021
SAV-ACL-010
SAV-ACL-003
SAV-ACL-004

MW-04	7/4/2016	Units
DRO	2.9 J-	mg/L
RRO	1.1 J-	mg/L
Toluene	1.2 J-	mg/L

MW-03	9/6/2016	Units
DRO	2.9	mg/L

SAV-ACL-015	8/25/2004	Units
DRO	30.2	mg/L
Benzene	0.0805	mg/L
Ethylbenzene	0.166	mg/L
Xylenes	0.581	mg/L

SAV-B-13	9/2/1998	Units	Depth (feet bgs)
DRO	17,000	mg/kg	0-0.5

SAV-B-12	9/2/1998	Units	Depth (feet bgs)
DRO	11,000	mg/kg	0.5-1

SAV-ACL-016	8/25/2004	Units
DRO	4.07	mg/L

11SAVSB001	7/6/2011	Units	Depth (feet bgs)
DRO	4,300	mg/kg	1-2
Benzene	0.27 J		
Ethylbenzene	11 J		
Xylenes	50 J		
Naphthalene	24		
1-Methylnaphthalene	30		
2-Methylnaphthalene	47		
DRO	17,000	mg/kg	2-2.6
Benzene	3		
Toluene	160		
Ethylbenzene	48		
Xylenes	250		
Naphthalene	180		
1-Methylnaphthalene	230		
2-Methylnaphthalene	360		

11SAVSB004	7/24/2011	Units
DRO	18 J	mg/L

MW-02	9/5/2016	Units
DRO	1.5 J-	mg/L
Toluene	1.8 J+	mg/L

Porewater	
Analyte	Table C Cleanup Level (mg/L)
DRO	1.5
RRO	1.1
Benzene	0.0046
Toluene	1.1
Ethylbenzene	0.015
Xylenes	0.19

Soil	
Analyte	Alternative Cleanup Level (mg/kg)
DRO	3000
Benzene	0.13
Toluene	47
Ethylbenzene	1.2
Xylenes	13
Naphthalene	0.43
1-Methylnaphthalene	4.9
2-Methylnaphthalene	15

LEGEND:

- Property Line
- Federal Scout Readiness Center (FSRC)
- Old FSRC
- Former Structures
- Former AST
- AST
- Day Tank
- Gravel Pad
- Soil concentrations exceeding ADEC-approved Alternative Cleanup Levels
- Tank Piping
- Other Building
- Unpaved Road
- Presumed Groundwater Flow Direction
- Former Drum Location

Porewater Sample Location

- All results less than Table C cleanup levels
- One or more result greater than Table C cleanup level

Soil Sample Location

- DRO < 250 mg/kg
- DRO ≥ 250 mg/kg, but < 3,000 mg/kg
- DRO ≥ 3,000 mg/kg
- DRO, BTEX, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene exceed alternative cleanup levels

Monitoring Well Locations Installed/Sampled in 2016

- All results less than Table C cleanup levels
- One or more result greater than Table C cleanup level

Abbreviations:

AST ..... aboveground storage tank
bgs ..... below ground surface
DRO ..... diesel-range organics
mg/kg ..... milligrams per kilogram
mg/L ..... milligrams per Liter
RRO ..... residual range organics

Notes:

1. Location of historical samples are approximate based on historical figures and on orthophotography courtesy of Alaska Department of Commerce, Division of Community & Regional Affairs (DCRA), 1-foot pixels.
2. All wells established prior to 2016 have been abandoned/removed.
3. Only porewater sample results with Table C exceedances are shown on figure.
4. Property boundary displayed is approximate.

Chemistry Notes:

1. J = estimated; the value is greater than or equal to the MDL and less than the LOQ, or the quantitation is an estimation due to discrepancies in meeting certain analyte-specific QC criteria
2. (+) = indicates that the result is potentially biased high
3. (–) = indicates that the result is potentially biased low

References:

1. Map produced using ESRI ArcMap v. 10.7.1.
2. Base imagery from ESRI (WV02, 50cm, 7/11/2014).

ALASKA STATE PLANE ZONE 9
HORIZONTAL DATUM: NAD83 (2011)
VERTICAL DATUM: NAVD88

15 7½ 0 15

SCALE IN FEET

PROJECT No.:	DATE:	FIGURE:
550501	6/22/2022	4
P.M.: MO	DRAWN: JC	

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1 INCH

WORK PLAN/UFP-QAPP
REMEDIAL ACTION
NATIONAL GUARD FEDERAL SCOUT ARMORY
SAVOONGA, ALASKA

PROPOSED EXCAVATION AND MW LOCATIONS



LEGEND:

- Property Line
- Federal Scout Readiness Center (FSRC)
- Old FSRC
- Former Structures
- Former AST
- AST
- Day Tank
- Gravel Pad
- Proposed Excavation Boundary
- Tank Piping
- Other Building
- Unpaved Road
- Presumed Groundwater Flow Direction
- Proposed Monitoring Well Location

Soil Sample Location

- DRO ≥ 3,000 mg/kg
- DRO, BTEX, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene exceed alternative cleanup levels

Monitoring Well Locations Installed/Sampled in 2016

- All results less than Table C cleanup levels
- One or more result greater than Table C cleanup level

Abbreviations:

AST ..... aboveground storage tank
bgs ..... below ground surface
DRO ..... diesel-range organics
mg/kg ..... milligrams per kilogram

Notes:

1. Location of historical samples are approximate based on historical figures and on orthophotography courtesy of Alaska Department of Commerce, Division of Community & Regional Affairs (DCRA), 1-foot pixels.
2. All wells established prior to 2016 have been abandoned/removed.
3. Only porewater sample results with Table C exceedances are shown on figure.
4. Proposed MW locations are approximate and will be installed within the FSRC property
5. Property boundary displayed is approximate.

Chemistry Notes:

1. J = estimated; the value is greater than or equal to the MDL and less than the LOQ, or the quantitation is an estimation due to discrepancies in meeting certain analyte-specific QC criteria
2. (+) = indicates that the result is potentially biased high
3. (–) = indicates that the result is potentially biased low

References:

1. Map produced using ESRI ArcMap v. 10.7.1.
2. Base imagery from ESRI (WV02, 50cm, 7/11/2014).

ALASKA STATE PLANE ZONE 9
HORIZONTAL DATUM: NAD83 (2011)
VERTICAL DATUM: NAVD88

15 7½ 0 15
SCALE IN FEET

PROJECT No.:	DATE:	FIGURE:
550501	6/22/2022	5
P.M.: MO	DRAWN: JC	

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APPENDIX A
COMMUNITY RELATIONS PLAN

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
ADEC	Alaska Department of Environmental Conservation
AKARNG	Alaska Army National Guard
ANCSA	Alaska Native Claims Settlement Act
Brice	Brice Engineering, LLC
CFMO	Construction and Facilities Management Officer
COR	Contracting Officer's Representative
CRP	Community Relations Plan
FSRC	Federal Scout Readiness Center
LTC	lieutenant colonel
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plan
USACE	United States Army Corps of Engineers

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1.0 INTRODUCTION

Brice Engineering, LLC (Brice) has prepared this Community Relations Plan (CRP) for the environmental services to be performed at the remote Federal Scout Readiness Center (FSRC) site located in Savoonga, Alaska for the U.S. Army Corps of Engineers (USACE) on behalf of Alaska Army National Guard (AKARNG) under Contract W911KB-17-D-0020. The following services will be provided to meet the project objectives at the Savoonga FSRC:

- Prepare Remedial Action Work Plan/Uniform Federal Policy for Quality Assurance Project Plan (UFP-QAPP) for USACE, AKARNG, and Alaska Department of Environmental Conservation (ADEC) review and approval.
- Perform fieldwork including the following activities:
- Excavate and remove up to 16 cubic yards (CY) of petroleum contaminated soils from the southeast side of the FSRC
- Collect approximately 10 confirmation samples from the limits of excavation(s)
- Install four temporary monitoring wells to the east and south of the AOC to characterize the eastern extent of supra-permafrost porewater impacted by historical petroleum releases.
- Prepare a report to document field activities and sample results.

The purpose of this CRP is to:

- Provide background information about the communities and areas potentially impacted by this project.
- Set forth strategies for communicating with agencies, stakeholders, and the public about the project.
- Foster open communications between the USACE, AKARNG, and residents living in Savoonga.
- Define the tools and timing for obtaining public involvement.

The USACE, AKARNG, and Brice believe public involvement is an important part of the cleanup process; all three parties are devoted to keeping the public informed and involved. This CRP and all other documents related to this process will be available for public review as they are finalized.

This project follows the ADEC regulations and technical guidance documents. Specific details regarding onsite activities are described in the main text of the Work Plan/UFP-QAPP.

1.1 Community Relations Objectives

The objectives of this CRP community involvement efforts are to:

- Obtain public input prior to finalizing decisions that may impact the community.
- Disseminate project information in a timely manner.
- Facilitate informed public input by providing relevant information at each milestone.
- Ensure that information is presented in an understandable way and is not overly or unnecessarily technical.
- Offer and seek participation from a broad range of the community, while reaching out to those who have been identified as key stakeholders.

2.0 STAKEHOLDERS

This section describes the roles and responsibilities of organizations that will participate in the implementation of this project. These organizations have specific functions according to their project responsibilities. The USACE, AKARNG, and Brice comprise the Project Team.

2.1 Key Stakeholders

2.1.1 Alaska Army National Guard

The AKARNG is the lead agency and is responsible for funding and overall direction, execution, and management of the project. The AKARNG holds statutory responsibility for performing environmental services at the Savoonga FSRC. The AKARNG Project Manager is the designated representative authorized to speak on behalf of the AKARNG in the environmental, regulatory, technical, or administrative matters.

2.1.2 U.S. Army Corps of Engineers

The USACE is the executing agent for the contract, manages contractor performance, ensures the work is performed in accordance with the SOW, and coordinates with the AKARNG PM. The USACE Project Manager is the prime contact and spokesperson for the project and has overall responsibility for the project.

2.1.3 Brice Engineering, LLC

Brice is the primary contractor. As such, Brice is responsible for performance and completion of field activities and coordination with local governments and agencies in conjunction with the performance of field activities at the Savoonga FSRC.

2.2 Regulatory Agencies

2.2.1 Alaska Department of Environmental Conservation

ADEC is the primary regulatory agency for the environmental services at the Savoonga FSRC site. Environmental services, including remedial actions, remedial investigation, and monitoring activities, will be performed in accordance with ADEC guidelines and standards. ADEC approval of the site-specific planning documents is required prior to performing fieldwork.

2.3 Savoonga Local Stakeholders

The village of Savoonga is located on a bluff of the northern coast of St. Lawrence Island along the Bering Sea (Figure 2). The Savoonga FSRC facility is located 400 feet south of the Bering Sea. Land to the south of Savoonga is hilly and is part of the Kookooligit Mountains. Atuk Mountain lies approximately 8 miles south of the village and rises to an elevation of 2,207 feet. Surface water near Savoonga includes the Bering Sea, the Kitnik River originating in the Kookooligit Mountains located approximately 2 miles east of the village, the Sivuungaq River directly east of the village, and various small lakes and ponds present to the southwest and southeast. East and west of the village, the land consists of bogs on relatively flat land (Ogden 1998).

Local corporations and traditional councils are the representatives of local stakeholders. Each organization is discussed in brief below.

2.3.1 Kukulget, Inc.

Kukulget, Inc. is the Alaska Native Village Corporation. This is one of 221 for-profit corporations that were created in ANCSA to own and manage lands in and around villages in Alaska. Kukulget, Inc. owns the land where the soil remediation is to take place. They also currently inhabit the armory buildings at this location.

2.3.2 Bering Straits Regional Corporation

Savoonga is located in the Bering Straits region and is managed by the Karawak Corporation (Kawerak, 2018). The Bering Straits Regional Corporation (BSRC) is one of thirteen Alaska Native Regional Corporations established in 1971 under the Alaska Native Claims Settlement Act (ANCSA) as a means of creating economic opportunities for Alaska Native shareholders in Alaska. The Bering Straits Region is located on the Seward Peninsula and outlying islands in northwest Alaska and has 17 villages within the region. The BSNC Board of Directors is chaired by Henry Ivanoff (Bering Straits 2021).

2.3.3 Village of Savoonga

The Native Village of Savoonga is a federally recognized tribe and provides guidance to tribal members based on traditional native values. The Native Village of Savoonga governs the village.

2.4 Stakeholder/Community Contacts List

Contact information for the key stakeholders listed above is summarized in Table 1. This table will become the basis for e-mails, direct mails, calls, meeting requests.

3.0 COMMUNITY RELATIONS

3.1 Community Setting and Context

Savoonga is located on St. Lawrence Island, Alaska and is one of two communities on the island. It is not accessible by the road system or by barge. Air is the most common method of travel to the community; however, locals utilize small boats, all-terrain vehicles, and snow machines for transportation and inter-village travel. Subsistence activities are central to the way of life in Savoonga (Alaska Community Database Online 2019).

3.2 Assessment of Interest and Identification of Stakeholders

Assessment of interest and identification of stakeholders will be based on informal interviews and meetings with local stakeholders that will take place in the months prior to the commencement of fieldwork.

The tribal government, Native Village of Savoonga, has authority in decision-making regarding the health and safety of the citizens of the tribe. The Alaska Native Corporation, Kukulget, Inc. has the authority for providing permission to dig on their land. Other entities, such as the City of Savoonga, the Alaska Native Regional Corporation (Bering Straits), and the associated non-profit corporation (Kawerak) may or may not have an interest in the workings for this remediation project. The will, however, be notified and provided opportunities to communicate their concerns and desires prior to beginning fieldwork.

3.3 Community Relations Approach: Involvement and Education

This CRP has two primary components: stakeholder involvement and community education. Stakeholder involvement offers a give-and-take approach to sharing ideas with the community and will be used to help shape the direction of the onsite environmental services field activities. Community education focuses on a one-way dissemination of information pertaining to the planning process. These two components of the CRP will be pursued simultaneously during USACE's, AKARNG's and Brice's community relations efforts.

The AKARNG recognizes the sovereignty of the Native Village of Savoonga for the land and people that they will be working with. The AKARNG will be sure to inform and listen to the tribal council on matters of concern for the people of Savoonga. The AKARNG will also keep in mind that the resources that they are working on are the possession of Kukulget, Inc. and as such, will be sure to inform and listen to the corporation's members regarding the handling of these assets.

3.4 Means and Methods

The project will seek stakeholder involvement through outreach activities. These efforts will provide stakeholders with pertinent information upon which they can review, comment, or make suggestions.

3.4.1 Site Visits/Onsite Meetings

A site visit is not anticipated prior to field operations. However, prior to kick-off of onsite field activities, an informal meeting will be held with the local stakeholders to assess potential interest in the project and to develop an understanding of the individuals and community groups the project should seek out and engage. Local stakeholders will be given the opportunity to ask questions and express concerns about the upcoming fieldwork during these meetings. If possible, stakeholder engagement and/or public involvement meetings will be collocated with previously scheduled community meetings or village council meetings. In addition, while fieldwork is in progress, the project team will continue to communicate with the local stakeholders as needed to address any questions or concerns related to the project.

3.4.2 Fact Sheet/Flyer

Prior to the commencement of field activities, a written notice will be delivered to the traditional village council and disseminated to the public outlining the fieldwork and any potential impacts to the communities.

A fact sheet or flyer will be developed to provide overview information about the onsite field activities. Fact sheets may also be developed to correspond with the key project milestones. Fact sheets will be distributed to the core group of stakeholders (village legislative branches and traditional councils).

The fact sheets will be more broadly distributed, if warranted, by community interest. Fact sheet and/or flyers may contain information on:

- Overall project information such as project goals
- Potential impacts to the community
- Projected timeline for the project
- Contact information for the project team

Distributions of fact sheets/flyers will be made via email to core community contacts. Contacts within the communities will be asked to disseminate information to their members. They may also choose to include the information in their community newsletters. Hard copies will be distributed to the legislative branch and/or traditional council in the village with a request that they be displayed in areas frequented by the public, such as at reception areas and bulletin boards.

3.4.3 Public Comment E-mails and Phone Contacts

The e-mail address of a project team representative will be provided on public communications (fact sheets/flyers) so that the public has a means of contacting a member of the project team to give comments, concerns, or questions. E-mail comments will be tracked, compiled, and responded to by project staff with USACE and AKARNG coordination and approval.

Brice will make phone calls to contact the local traditional village council prior to the commencement of onsite field activities.

3.5 Schedule of Community Relations Activities

Table 2 presents the community relations schedule for the field activities planned at the Savoonga FSRC site.

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Table A-1 Stakeholder/Community Contacts List

Name	Title and Organization	Phone Number	Address	Email
Stakeholders/Contacts				
Heidi Long	Project Manager, USACE	(907) 244-0618	4511 8th Street Fort Wainwright, AK, 99703	heidi.l.long@usace.army.mil
Timothy Clapp	Contracting Officer, USACE	(907) 753-2836	PO Box 6898 JBER, AK 99506-0898	timothy.l.clapp@usace.army.mil
Mike Utley	Contracting Officer's Representative, USACE	(907) 753-2691	PO Box 6898 JBER, AK 99506-0898	michael.d.utley@usace.army.mil
LTC Eric Marcellus	CFMO, AKARNG	(907) 428-6750	PO Box 5169 JBER, AK 99505	eric.l.marcellus.mil@army.mil
Jenna Van Horn	Project Manager, AKARNG	(907) 428-7696	PO Box 5800 JBER, AK 99505-0800	jenna.vanhorn@alaska.gov
Flannery Ballard	Project Manager, ADEC	(907) 465-5368	410 Willoughby Ave #303 Juneau, AK 99801	flannery.ballard@alaska.gov
Monica Oakley	Program Manager, Brice	(907) 275-2914	3800 Centerpoint Drive, Suite 417 Anchorage, AK 99503	monica.oakley@briceenvironmental.com
Monte Garroutte	Field Manager, Brice	(907) 750-8688	3800 Centerpoint Drive, Suite 417 Anchorage, AK 99503	mgarroutte@briceenvironmental.com
Savoonga				
Tribal Administrator	Native Village of Savoonga	(907) 984-6414	PO Box 120 Savoonga, AK 99769	tc.sva@kawerak.org
Chairperson	Kukulget, Inc.	(907) 984-6184	PO Box 160 Savoonga, AK 99769	None
Ben Pungowiyi	Savoonga Representative, Kawerak Corporation	(907) 443-5231	P.O. Box 948 Nome, AK 99762	contact@kawerak.org
Henry Ivanoff	Bering Straits Board of Directors Chairman	(907) 443-5252	P.O. Box 1008 110 Front Street, Suite 300 Nome, Alaska 99762	info@beringstraits.com
Myron Kingeekuk	Mayor of Savoonga	(907) 984-6614	P.O. Box 40 Savoonga, AK 99769	Cityofsva@yahoo.com

Notes:

For definitions, refer to Acronyms and Abbreviations section.

This list of Stakeholders will generally be contacted in instances when the Project Team is providing Public Notices, or at main milestone points, such as when fieldwork begins or ends. Additional stakeholders may be identified as the project proceeds.

Table A-2 Schedule of Community Relations Activities

Date	Task/Activity	Community Relations Activity					
		Fact Sheet, Flyer	Email, Mail	Letter Correspondence	Onsite Meeting	Phone	Admin Record
May 2022	Written notification to the Savoonga stakeholders	X	X	X			X
June 2022	Delivery of site-specific planning documents to Savoonga stakeholders		X	X			X
Early July 2022	Notification of fieldwork commencement					X	
Early-Mid July 2022	Ongoing communications with Savoonga stakeholders during onsite field activities				X	X	
December 2022	Delivery of site-specific reports to Savoonga stakeholders		X	X			X

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4.0 REFERENCES

Alaska Community Database Online. 2019. DCRA Open Data. https://dcra-cdo-dcced.opendata.arcgis.com/. Accessed 11 January 2019.

Bering Straits Corporation. 2021. *Board of Directors.* https://beringstraits.com/board-of-directors. Accessed 19 November 2021.

Kawerak Corporation, Inc. 2018. *Board of Directors.* http://Kawerak.org/our-region/savoonga. Accessed 16 November 2021.

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APPENDIX B
LABORATORY CERTIFICATIONS

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Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
83-32-9	Soil	Acenaphthene	8270D	A2LA
83-32-9	Water	Acenaphthene	8270D	A2LA
83-32-9	Soil	Acenaphthene	8270D-SIM	A2LA
83-32-9	Water	Acenaphthene	8270D-SIM	A2LA
208-96-8	Soil	Acenaphthylene	8270D	A2LA
208-96-8	Water	Acenaphthylene	8270D	A2LA
208-96-8	Soil	Acenaphthylene	8270D-SIM	A2LA
208-96-8	Water	Acenaphthylene	8270D-SIM	A2LA
67-64-1	Soil	Acetone	8260D	A2LA
67-64-1	Water	Acetone	8260D	A2LA
309-00-2	Soil	Aldrin	8270D-SIM	A2LA
309-00-2	Water	Aldrin	8270D-SIM	A2LA
120-12-7	Soil	Anthracene	8270D	A2LA
120-12-7	Water	Anthracene	8270D	A2LA
120-12-7	Soil	Anthracene	8270D-SIM	A2LA
120-12-7	Water	Anthracene	8270D-SIM	A2LA
7440-36-0	Soil	Antimony (metallic)	6020B	A2LA
7440-36-0	Water	Antimony (metallic)	6020B	A2LA
7440-38-2	Soil	Arsenic, Inorganic	6020B	A2LA
7440-38-2	Water	Arsenic, Inorganic	6020B	A2LA
7440-39-3	Soil	Barium	6020B	A2LA
7440-39-3	Water	Barium	6020B	A2LA
56-55-3	Soil	Benz[a]anthracene	8270D	A2LA
56-55-3	Water	Benz[a]anthracene	8270D	A2LA
56-55-3	Soil	Benz[a]anthracene	8270D-SIM	A2LA
56-55-3	Water	Benz[a]anthracene	8270D-SIM	A2LA
71-43-2	Soil	Benzene	8260D	A2LA
71-43-2	Water	Benzene	8260D	A2LA
50-32-8	Soil	Benzo[a]pyrene	8270D	A2LA
50-32-8	Water	Benzo[a]pyrene	8270D	A2LA
205-99-2	Soil	Benzo[b]fluoranthene	8270D	A2LA
205-99-2	Water	Benzo[b]fluoranthene	8270D	A2LA
205-99-2	Soil	Benzo[b]fluoranthene	8270D-SIM	A2LA

Scope of Approval

CAS Number	Matrix	Hazardous Substance	Method	Accreditation Body
205-99-2	Water	Benzo[b]fluoranthene	8270D-SIM	A2LA
191-24-2	Soil	Benzo[g,h,i]perylene	8270D	A2LA
191-24-2	Water	Benzo[g,h,i]perylene	8270D	A2LA
191-24-2	Soil	Benzo[g,h,i]perylene	8270D-SIM	A2LA
191-24-2	Water	Benzo[g,h,i]perylene	8270D-SIM	A2LA
207-08-9	Soil	Benzo[k]fluoranthene	8270D	A2LA
207-08-9	Water	Benzo[k]fluoranthene	8270D	A2LA
207-08-9	Soil	Benzo[k]fluoranthene	8270D-SIM	A2LA
207-08-9	Water	Benzo[k]fluoranthene	8270D-SIM	A2LA
65-85-0	Soil	Benzoic Acid	8270D	A2LA
65-85-0	Water	Benzoic Acid	8270D	A2LA
100-51-6	Soil	Benzyl Alcohol	8270D	A2LA
100-51-6	Water	Benzyl Alcohol	8270D	A2LA
7440-41-7	Soil	Beryllium and compounds	6020B	A2LA
7440-41-7	Water	Beryllium and compounds	6020B	A2LA
111-44-4	Soil	Bis(2-chloroethyl)ether	8270D	A2LA
111-44-4	Water	Bis(2-chloroethyl)ether	8270D	A2LA
117-81-7	Soil	Bis(2-ethylhexyl)phthalate (DEHP)	8270D	A2LA
117-81-7	Water	Bis(2-ethylhexyl)phthalate (DEHP)	8270D	A2LA
108-86-1	Soil	Bromobenzene	8260D	A2LA
108-86-1	Water	Bromobenzene	8260D	A2LA
75-27-4	Soil	Bromodichloromethane	8260D	A2LA
75-27-4	Water	Bromodichloromethane	8260D	A2LA
75-25-2	Soil	Bromoform	8260D	A2LA
75-25-2	Water	Bromoform	8260D	A2LA
74-83-9	Soil	Bromomethane	8260D	A2LA
74-83-9	Water	Bromomethane	8260D	A2LA
85-68-7	Soil	Butyl Benzyl Phthalate	8270D	A2LA
85-68-7	Water	Butyl Benzyl Phthalate	8270D	A2LA
104-51-8	Soil	Butylbenzene, n-	8260D	A2LA
104-51-8	Water	Butylbenzene, n-	8260D	A2LA
135-98-8	Soil	Butylbenzene, sec-	8260D	A2LA
135-98-8	Water	Butylbenzene, sec-	8260D	A2LA

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98-06-6	Soil	Butylbenzene, tert-	8260D	A2LA
98-06-6	Water	Butylbenzene, tert-	8260D	A2LA
7440-43-9	Soil	Cadmium	6020B	A2LA
7440-43-9	Water	Cadmium	6020B	A2LA
75-15-0	Soil	Carbon Disulfide	8260D	A2LA
75-15-0	Water	Carbon Disulfide	8260D	A2LA
56-23-5	Soil	Carbon Tetrachloride	8260D	A2LA
56-23-5	Water	Carbon Tetrachloride	8260D	A2LA
5103-71-9	Soil	Chlordane, α-	8270D-SIM	A2LA
5103-71-9	Water	Chlordane, α-	8270D-SIM	A2LA
5103-74-2	Soil	Chlordane, γ-	8270D-SIM	A2LA
5103-74-2	Water	Chlordane, γ-	8270D-SIM	A2LA
12789-03-6	Soil	Chlordane, Total	8270D-SIM	A2LA
12789-03-6	Water	Chlordane, Total	8270D-SIM	A2LA
106-47-8	Soil	Chloroaniline, p-	8270D	A2LA
106-47-8	Water	Chloroaniline, p-	8270D	A2LA
108-90-7	Soil	Chlorobenzene	8260D	A2LA
108-90-7	Water	Chlorobenzene	8260D	A2LA
67-66-3	Soil	Chloroform	8260D	A2LA
67-66-3	Water	Chloroform	8260D	A2LA
74-87-3	Soil	Chloromethane	8260D	A2LA
74-87-3	Water	Chloromethane	8260D	A2LA
91-58-7	Soil	Chloronaphthalene, Beta-	8270D	A2LA
91-58-7	Water	Chloronaphthalene, Beta-	8270D	A2LA
7440-47-3	Soil	Chromium (Total)	6020B	A2LA
7440-47-3	Water	Chromium (Total)	6020B	A2LA
218-01-9	Soil	Chrysene	8270D	A2LA
218-01-9	Water	Chrysene	8270D	A2LA
7440-50-8	Soil	Copper	6020B	A2LA
7440-50-8	Water	Copper	6020B	A2LA
N/A	Soil	Cresol, m- (3-Methylphenol) + Cresol, p- (4-Methylphenol)	8270D	A2LA
N/A	Water	Cresol, m- (3-Methylphenol) + Cresol, p- (4-Methylphenol)	8270D	A2LA
95-48-7	Soil	Cresol, o- (2-Methylphenol)	8270D	A2LA

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95-48-7	Water	Cresol, o- (2-Methylphenol)	8270D	A2LA
72-54-8	Soil	DDD, 4,4'-	8270D-SIM	A2LA
72-54-8	Water	DDD, 4,4'-	8270D-SIM	A2LA
72-55-9	Soil	DDE, 4,4'-	8270D-SIM	A2LA
72-55-9	Water	DDE, 4,4'-	8270D-SIM	A2LA
50-29-3	Soil	DDT, 4,4'-	8270D-SIM	A2LA
50-29-3	Water	DDT, 4,4'-	8270D-SIM	A2LA
53-70-3	Soil	Dibenz[a,h]anthracene	8270D	A2LA
53-70-3	Water	Dibenz[a,h]anthracene	8270D	A2LA
132-64-9	Soil	Dibenzofuran	8270D	A2LA
132-64-9	Water	Dibenzofuran	8270D	A2LA
124-48-1	Soil	Dibromochloromethane	8260D	A2LA
124-48-1	Water	Dibromochloromethane	8260D	A2LA
106-93-4	Soil	Dibromoethane, 1,2- (Ethylene Dibromide)	8260D	A2LA
106-93-4	Water	Dibromoethane, 1,2- (Ethylene Dibromide)	8260D	A2LA
106-93-4	Soil	Dibromoethane, 1,2- (Ethylene Dibromide)	8260D-SIM	A2LA
106-93-4	Water	Dibromoethane, 1,2- (Ethylene Dibromide)	8260D-SIM	A2LA
74-95-3	Soil	Dibromomethane (Methylene Bromide)	8260D	A2LA
74-95-3	Water	Dibromomethane (Methylene Bromide)	8260D	A2LA
84-74-2	Soil	Dibutyl Phthalate	8270D	A2LA
84-74-2	Water	Dibutyl Phthalate	8270D	A2LA
95-50-1	Soil	Dichlorobenzene, 1,2-	8260D	A2LA
95-50-1	Water	Dichlorobenzene, 1,2-	8260D	A2LA
95-50-1	Soil	Dichlorobenzene, 1,2-	8270D	A2LA
95-50-1	Water	Dichlorobenzene, 1,2-	8270D	A2LA
541-73-1	Soil	Dichlorobenzene, 1,3-	8260D	A2LA
541-73-1	Water	Dichlorobenzene, 1,3-	8260D	A2LA
541-73-1	Soil	Dichlorobenzene, 1,3-	8270D	A2LA
541-73-1	Water	Dichlorobenzene, 1,3-	8270D	A2LA
106-46-7	Soil	Dichlorobenzene, 1,4-	8260D	A2LA
106-46-7	Water	Dichlorobenzene, 1,4-	8260D	A2LA
106-46-7	Soil	Dichlorobenzene, 1,4-	8270D	A2LA
106-46-7	Water	Dichlorobenzene, 1,4-	8270D	A2LA

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91-94-1	Soil	Dichlorobenzidine, 3,3'-	8270D	A2LA
91-94-1	Water	Dichlorobenzidine, 3,3'-	8270D	A2LA
75-71-8	Soil	Dichlorodifluoromethane (Freon-12)	8260D	A2LA
75-71-8	Water	Dichlorodifluoromethane (Freon-12)	8260D	A2LA
75-34-3	Soil	Dichloroethane, 1,1-	8260D	A2LA
75-34-3	Water	Dichloroethane, 1,1-	8260D	A2LA
107-06-2	Soil	Dichloroethane, 1,2-	8260D	A2LA
107-06-2	Water	Dichloroethane, 1,2-	8260D	A2LA
75-35-4	Soil	Dichloroethylene, 1,1-	8260D	A2LA
75-35-4	Water	Dichloroethylene, 1,1-	8260D	A2LA
156-59-2	Soil	Dichloroethylene, 1,2-cis-	8260D	A2LA
156-59-2	Water	Dichloroethylene, 1,2-cis-	8260D	A2LA
156-60-5	Soil	Dichloroethylene, 1,2-trans-	8260D	A2LA
156-60-5	Water	Dichloroethylene, 1,2-trans-	8260D	A2LA
120-83-2	Soil	Dichlorophenol, 2,4-	8270D	A2LA
120-83-2	Water	Dichlorophenol, 2,4-	8270D	A2LA
78-87-5	Soil	Dichloropropane, 1,2-	8260D	A2LA
78-87-5	Water	Dichloropropane, 1,2-	8260D	A2LA
10061-01-5	Soil	Dichloropropene, cis-1,3-	8260D	A2LA
10061-01-5	Water	Dichloropropene, cis-1,3-	8260D	A2LA
10061-02-6	Soil	Dichloropropene, trans-1,3-	8260D	A2LA
10061-02-6	Water	Dichloropropene, trans-1,3-	8260D	A2LA
60-57-1	Soil	Dieldrin	8270D-SIM	A2LA
60-57-1	Water	Dieldrin	8270D-SIM	A2LA
N/A	Soil	Diesel Range Organics (C10 – C25)	AK 102	A2LA
N/A	Water	Diesel Range Organics (C10 – C25)	AK 102	A2LA
84-66-2	Soil	Diethyl Phthalate	8270D	A2LA
84-66-2	Water	Diethyl Phthalate	8270D	A2LA
105-67-9	Soil	Dimethylphenol, 2,4-	8270D	A2LA
105-67-9	Water	Dimethylphenol, 2,4-	8270D	A2LA
131-11-3	Soil	Dimethylphthalate	8270D	A2LA
131-11-3	Water	Dimethylphthalate	8270D	A2LA
51-28-5	Soil	Dinitrophenol, 2,4-	8270D	A2LA

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51-28-5	Water	Dinitrophenol, 2,4-	8270D	A2LA
121-14-2	Soil	Dinitrotoluene, 2,4- (2,4-DNT)	8270D	A2LA
121-14-2	Water	Dinitrotoluene, 2,4- (2,4-DNT)	8270D	A2LA
606-20-2	Soil	Dinitrotoluene, 2,6- (2,6-DNT)	8270D	A2LA
606-20-2	Water	Dinitrotoluene, 2,6- (2,6-DNT)	8270D	A2LA
123-91-1	Soil	Dioxane, 1,4-	8260D-SIM	A2LA
123-91-1	Water	Dioxane, 1,4-	8260D-SIM	A2LA
959-98-8	Soil	Endosulfan I	8270D-SIM	A2LA
959-98-8	Water	Endosulfan I	8270D-SIM	A2LA
33213-65-9	Soil	Endosulfan II	8270D-SIM	A2LA
33213-65-9	Water	Endosulfan II	8270D-SIM	A2LA
1031-07-8	Soil	Endosulfan sulfate	8270D-SIM	A2LA
1031-07-8	Water	Endosulfan sulfate	8270D-SIM	A2LA
72-20-8	Soil	Endrin	8270D-SIM	A2LA
72-20-8	Water	Endrin	8270D-SIM	A2LA
75-00-3	Soil	Ethyl Chloride	8260D	A2LA
75-00-3	Water	Ethyl Chloride	8260D	A2LA
100-41-4	Soil	Ethylbenzene	8260D	A2LA
100-41-4	Water	Ethylbenzene	8260D	A2LA
206-44-0	Soil	Fluoranthene	8270D	A2LA
206-44-0	Water	Fluoranthene	8270D	A2LA
86-73-7	Soil	Fluorene	8270D	A2LA
86-73-7	Water	Fluorene	8270D	A2LA
N/A	Soil	Gasoline Range Organics (C6 – C10)	AK 101	A2LA
N/A	Water	Gasoline Range Organics (C6 – C10)	AK 101	A2LA
76-44-8	Soil	Heptachlor	8270D-SIM	A2LA
76-44-8	Water	Heptachlor	8270D-SIM	A2LA
1024-57-3	Soil	Heptachlor Epoxide	8270D-SIM	A2LA
1024-57-3	Water	Heptachlor Epoxide	8270D-SIM	A2LA
118-74-1	Soil	Hexachlorobenzene	8270D	A2LA
118-74-1	Water	Hexachlorobenzene	8270D	A2LA
87-68-3	Soil	Hexachlorobutadiene	8260D	A2LA
87-68-3	Water	Hexachlorobutadiene	8260D	A2LA

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87-68-3	Soil	Hexachlorobutadiene	8270D	A2LA
87-68-3	Water	Hexachlorobutadiene	8270D	A2LA
77-47-4	Soil	Hexachlorocyclopentadiene	8270D	A2LA
77-47-4	Water	Hexachlorocyclopentadiene	8270D	A2LA
67-72-1	Soil	Hexachloroethane	8270D	A2LA
67-72-1	Water	Hexachloroethane	8270D	A2LA
591-78-6	Soil	Hexanone, 2-	8260D	A2LA
591-78-6	Water	Hexanone, 2-	8260D	A2LA
193-39-5	Soil	Indeno[1,2,3-cd]pyrene	8270D	A2LA
193-39-5	Water	Indeno[1,2,3-cd]pyrene	8270D	A2LA
78-59-1	Soil	Isophorone	8270D	A2LA
78-59-1	Water	Isophorone	8270D	A2LA
7439-92-1	Soil	Lead, Total	6020B	A2LA
7439-92-1	Water	Lead, Total	6020B	A2LA
7439-96-5	Soil	Manganese	6020B	A2LA
7439-96-5	Water	Manganese	6020B	A2LA
7439-97-6	Soil	Mercury (elemental)	6020B	A2LA
7439-97-6	Water	Mercury (elemental)	6020B	A2LA
72-43-5	Soil	Methoxychlor	8270D-SIM	A2LA
72-43-5	Water	Methoxychlor	8270D-SIM	A2LA
78-93-3	Soil	Methyl Ethyl Ketone (2-Butanone)	8260D	A2LA
78-93-3	Water	Methyl Ethyl Ketone (2-Butanone)	8260D	A2LA
108-10-1	Soil	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	8260D	A2LA
108-10-1	Water	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	8260D	A2LA
1634-04-4	Soil	Methyl tert-Butyl Ether (MTBE)	8260D	A2LA
1634-04-4	Water	Methyl tert-Butyl Ether (MTBE)	8260D	A2LA
75-09-2	Soil	Methylene Chloride	8260D	A2LA
75-09-2	Water	Methylene Chloride	8260D	A2LA
90-12-0	Soil	Methylnaphthalene, 1-	8270D	A2LA
90-12-0	Water	Methylnaphthalene, 1-	8270D	A2LA
90-12-0	Soil	Methylnaphthalene, 1-	8270D-SIM	A2LA
90-12-0	Water	Methylnaphthalene, 1-	8270D-SIM	A2LA
91-57-6	Soil	Methylnaphthalene, 2-	8270D	A2LA

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91-57-6	Water	Methylnaphthalene, 2-	8270D	A2LA
91-57-6	Soil	Methylnaphthalene, 2-	8270D-SIM	A2LA
91-57-6	Water	Methylnaphthalene, 2-	8270D-SIM	A2LA
91-20-3	Soil	Naphthalene	8260D	A2LA
91-20-3	Water	Naphthalene	8260D	A2LA
91-20-3	Soil	Naphthalene	8270D	A2LA
91-20-3	Water	Naphthalene	8270D	A2LA
91-20-3	Soil	Naphthalene	8270D-SIM	A2LA
91-20-3	Water	Naphthalene	8270D-SIM	A2LA
7440-02-0	Soil	Nickel, Total	6020B	A2LA
7440-02-0	Water	Nickel, Total	6020B	A2LA
98-95-3	Soil	Nitrobenzene	8270D	A2LA
98-95-3	Water	Nitrobenzene	8270D	A2LA
62-75-9	Soil	Nitrosodimethylamine, N-	8270D	A2LA
62-75-9	Water	Nitrosodimethylamine, N-	8270D	A2LA
621-64-7	Soil	Nitroso-di-N-propylamine, N-	8270D	A2LA
621-64-7	Water	Nitroso-di-N-propylamine, N-	8270D	A2LA
86-30-6	Soil	Nitrosodiphenylamine, N-	8270D	A2LA
86-30-6	Water	Nitrosodiphenylamine, N-	8270D	A2LA
12674-11-2	Soil	PCB - Aroclor-1016	8082A	A2LA
12674-11-2	Water	PCB - Aroclor-1016	8082A	A2LA
11104-28-2	Soil	PCB - Aroclor-1221	8082A	A2LA
11104-28-2	Water	PCB - Aroclor-1221	8082A	A2LA
11141-16-5	Soil	PCB - Aroclor-1232	8082A	A2LA
11141-16-5	Water	PCB - Aroclor-1232	8082A	A2LA
53469-21-9	Soil	PCB - Aroclor-1242	8082A	A2LA
53469-21-9	Water	PCB - Aroclor-1242	8082A	A2LA
12672-29-6	Soil	PCB - Aroclor-1248	8082A	A2LA
12672-29-6	Water	PCB - Aroclor-1248	8082A	A2LA
11097-69-1	Soil	PCB - Aroclor-1254	8082A	A2LA
11097-69-1	Water	PCB - Aroclor-1254	8082A	A2LA
11096-82-5	Soil	PCB - Aroclor-1260	8082A	A2LA
11096-82-5	Water	PCB - Aroclor-1260	8082A	A2LA

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N/A	Soil	PCB – Total	8082A	A2LA
N/A	Water	PCB – Total	8082A	A2LA
87-86-5	Soil	Pentachlorophenol	8270D	A2LA
87-86-5	Water	Pentachlorophenol	8270D	A2LA
85-01-8	Soil	Phenanthrene	8270D	A2LA
85-01-8	Water	Phenanthrene	8270D	A2LA
85-01-8	Soil	Phenanthrene	8270D-SIM	A2LA
85-01-8	Water	Phenanthrene	8270D-SIM	A2LA
108-95-2	Soil	Phenol	8270D	A2LA
108-95-2	Water	Phenol	8270D	A2LA
103-65-1	Soil	Propyl benzene	8260D	A2LA
103-65-1	Water	Propyl benzene	8260D	A2LA
129-00-0	Soil	Pyrene	8270D	A2LA
129-00-0	Water	Pyrene	8270D	A2LA
129-00-0	Soil	Pyrene	8270D-SIM	A2LA
129-00-0	Water	Pyrene	8270D-SIM	A2LA
N/A	Soil	Residual Range Organics (C25 – C36)	AK 103	A2LA
N/A	Water	Residual Range Organics (C25 – C36)	AK 103	A2LA
7782-49-2	Soil	Selenium	6020B	A2LA
7782-49-2	Water	Selenium	6020B	A2LA
7440-22-4	Soil	Silver	6020B	A2LA
7440-22-4	Water	Silver	6020B	A2LA
7440-24-6	Soil	Strontium	6020B	A2LA
7440-24-6	Water	Strontium	6020B	A2LA
100-42-5	Soil	Styrene	8260D	A2LA
100-42-5	Water	Styrene	8260D	A2LA
630-20-6	Soil	Tetrachloroethane, 1,1,1,2-	8260D	A2LA
630-20-6	Water	Tetrachloroethane, 1,1,1,2-	8260D	A2LA
79-34-5	Soil	Tetrachloroethane, 1,1,2,2-	8260D	A2LA
79-34-5	Water	Tetrachloroethane, 1,1,2,2-	8260D	A2LA
127-18-4	Soil	Tetrachloroethylene	8260D	A2LA
127-18-4	Water	Tetrachloroethylene	8260D	A2LA
7440-28-0	Soil	Thallium, Total	6020B	A2LA

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7440-28-0	Water	Thallium, Total	6020B	A2LA
108-88-3	Soil	Toluene	8260D	A2LA
108-88-3	Water	Toluene	8260D	A2LA
8001-35-2	Soil	Toxaphene	8270D-SIM	A2LA
8001-35-2	Water	Toxaphene	8270D-SIM	A2LA
76-13-1	Soil	Trichloro-1,2,2-trifluoroethane, 1,1,2- (Freon 113)	8260D	A2LA
76-13-1	Water	Trichloro-1,2,2-trifluoroethane, 1,1,2- (Freon 113)	8260D	A2LA
87-61-6	Soil	Trichlorobenzene, 1,2,3-	8260D	A2LA
87-61-6	Water	Trichlorobenzene, 1,2,3-	8260D	A2LA
120-82-1	Soil	Trichlorobenzene, 1,2,4-	8260D	A2LA
120-82-1	Water	Trichlorobenzene, 1,2,4-	8260D	A2LA
120-82-1	Soil	Trichlorobenzene, 1,2,4-	8270D	A2LA
120-82-1	Water	Trichlorobenzene, 1,2,4-	8270D	A2LA
71-55-6	Soil	Trichloroethane, 1,1,1-	8260D	A2LA
71-55-6	Water	Trichloroethane, 1,1,1-	8260D	A2LA
79-00-5	Soil	Trichloroethane, 1,1,2-	8260D	A2LA
79-00-5	Water	Trichloroethane, 1,1,2-	8260D	A2LA
79-01-6	Soil	Trichloroethylene	8260D	A2LA
79-01-6	Water	Trichloroethylene	8260D	A2LA
75-69-4	Soil	Trichlorofluoromethane	8260D	A2LA
75-69-4	Water	Trichlorofluoromethane	8260D	A2LA
95-95-4	Soil	Trichlorophenol, 2,4,5-	8270D	A2LA
95-95-4	Water	Trichlorophenol, 2,4,5-	8270D	A2LA
88-06-2	Soil	Trichlorophenol, 2,4,6-	8270D	A2LA
88-06-2	Water	Trichlorophenol, 2,4,6-	8270D	A2LA
96-18-4	Soil	Trichloropropane, 1,2,3-	8260D	A2LA
96-18-4	Water	Trichloropropane, 1,2,3-	8260D	A2LA
96-18-4	Soil	Trichloropropane, 1,2,3-	8260D-SIM	A2LA
96-18-4	Water	Trichloropropane, 1,2,3-	8260D-SIM	A2LA
95-63-6	Soil	Trimethylbenzene, 1,2,4-	8260D	A2LA
95-63-6	Water	Trimethylbenzene, 1,2,4-	8260D	A2LA
108-67-8	Soil	Trimethylbenzene, 1,3,5-	8260D	A2LA
108-67-8	Water	Trimethylbenzene, 1,3,5-	8260D	A2LA

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7440-62-2	Soil	Vanadium, Total	6020B	A2LA
7440-62-2	Water	Vanadium, Total	6020B	A2LA
108-05-4	Soil	Vinyl Acetate	8260D	A2LA
108-05-4	Water	Vinyl Acetate	8260D	A2LA
75-01-4	Soil	Vinyl Chloride	8260D	A2LA
75-01-4	Water	Vinyl Chloride	8260D	A2LA
179601-23-1	Soil	Xylene, m+p-	8260D	A2LA
179601-23-1	Water	Xylene, m+p-	8260D	A2LA
95-47-6	Soil	Xylene, o-	8260D	A2LA
95-47-6	Water	Xylene, o-	8260D	A2LA
1330-20-7	Soil	Xylene, Total	8260D	A2LA
1330-20-7	Water	Xylene, Total	8260D	A2LA
7440-66-6	Soil	Zinc, Total	6020B	A2LA
7440-66-6	Water	Zinc, Total	6020B	A2LA

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SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

SGS NORTH AMERICA INC. – ALASKA DIVISION
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ENVIRONMENTAL

Valid To: December 31, 2023 Certificate Number: 2944.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO/IEC 17025:2017, the 2009 TNI Environmental Testing Laboratory Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.4 of the DoD/DOE Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Inductively Coupled Plasma Mass Spectroscopy, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Ion Chromatography, Hazardous Waste Characteristics Tests, Total Organic Carbon

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
Metals		
Aluminum	EPA 6020B	EPA 6020B
Antimony	EPA 6020B	EPA 6020B
Arsenic	EPA 6020B	EPA 6020B
Barium	EPA 6020B	EPA 6020B
Beryllium	EPA 6020B	EPA 6020B
Boron	EPA 6020B	EPA 6020B
Cadmium	EPA 6020B	EPA 6020B
Calcium	EPA 6020B	EPA 6020B
Chromium	EPA 6020B	EPA 6020B
Cobalt	EPA 6020B	EPA 6020B
Copper	EPA 6020B	EPA 6020B
Iron	EPA 6020B	EPA 6020B
Lead	EPA 6020B	EPA 6020B
Magnesium	EPA 6020B	EPA 6020B
Manganese	EPA 6020B	EPA 6020B
Mercury	EPA 6020B EPA 7470A	EPA 6020B EPA 7471A
Molybdenum	EPA 6020B	EPA 6020B

5202 Presidents Court, Suite 220 | Frederick, MD 21703-8398 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

Parameter/Analyte	Solid & Chemical Materials	
	Aqueous	**Solid**
Nickel	EPA 6020B	EPA 6020B
Potassium	EPA 6020B	EPA 6020B
Selenium	EPA 6020B	EPA 6020B
Silver	EPA 6020B	EPA 6020B
Sodium	EPA 6020B	EPA 6020B
Strontium	EPA 6020B	EPA 6020B
Thallium	EPA 6020B	EPA 6020B
Vanadium	EPA 6020B	EPA 6020B
Zinc	EPA 6020B	EPA 6020B
Metals Digestion Methods Toxicity Characteristic Leaching Procedure	EPA 3010A EPA 1311	EPA 3050B EPA 1311
Nutrients		
Nitrate (as N)	EPA 9056A	EPA 9056A
Nitrate + Nitrite (as N)	EPA 9056A	EPA 9056A
Nitrite (as N)	EPA 9056A	EPA 9056A
Demands		
Total Organic Carbon	EPA 9060A	EPA 9060A
Wet Chemistry		
Bromide	EPA 9056A	EPA 9056A
Chloride	EPA 9056A	EPA 9056A
Fluoride	EPA 9056A	EPA 9056A
Sulfate	EPA 9056A	EPA 9056A
Purgeable Organics (Volatiles)		
Acetone	EPA 8260D	EPA 8260D
Benzene	EPA 8260D EPA 8021B	EPA 8260D EPA 8021B
Bromobenzene	EPA 8260D	EPA 8260D
Bromochloromethane	EPA 8260D	EPA 8260D
Bromodichloromethane	EPA 8260D	EPA 8260D
Bromoform	EPA 8260D	EPA 8260D
Bromomethane	EPA 8260D	EPA 8260D
2-Butanone	EPA 8260D	EPA 8260D
n-Butylbenzene	EPA 8260D	EPA 8260D
sec-Butylbenzene	EPA 8260D	EPA 8260D
tert-Butylbenzene	EPA 8260D	EPA 8260D
Carbon Disulfide	EPA 8260D	EPA 8260D
Carbon Tetrachloride	EPA 8260D	EPA 8260D
Chlorobenzene	EPA 8260D	EPA 8260D
Chloroethane	EPA 8260D	EPA 8260D
Chloroform	EPA 8260D	EPA 8260D
Chloromethane	EPA 8260D	EPA 8260D

Parameter/Analyte	Solid & Chemical Materials	
	Aqueous	Solid
2-Chlorotoluene	EPA 8260D	EPA 8260D
4-Chlorotoluene	EPA 8260D	EPA 8260D
Dibromochloromethane	EPA 8260D	EPA 8260D
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260D EPA 8260D SIM	EPA 8260D EPA 8260D SIM
Dibromomethane	EPA 8260D	EPA 8260D
1,2-Dibromoethane (EDB)	EPA 8260D EPA 8260D SIM	EPA 8260D EPA 8260D SIM
1,2-Dichlorobenzene	EPA 8260D	EPA 8260D
1,3-Dichlorobenzene	EPA 8260D	EPA 8260D
1,4-Dichlorobenzene	EPA 8260D	EPA 8260D
Dichlorodifluoromethane	EPA 8260D	EPA 8260D
1,1-Dichloroethane	EPA 8260D	EPA 8260D
1,2-Dichloroethane	EPA 8260D	EPA 8260D
1,1-Dichloroethene	EPA 8260D	EPA 8260D
cis-1,2-Dichloroethene	EPA 8260D	EPA 8260D
trans-1,2-Dichloroethene	EPA 8260D	EPA 8260D
1,2-Dichloropropane	EPA 8260D	EPA 8260D
1,3-Dichloropropane	EPA 8260D	EPA 8260D
2,2-Dichloropropane	EPA 8260D	EPA 8260D
1,1-Dichloropropene	EPA 8260D	EPA 8260D
cis-1,3-Dichloropropene	EPA 8260D	EPA 8260D
trans-1,3-Dichloropropene	EPA 8260D	EPA 8260D
1,4-Dioxane	EPA 8260D SIM	EPA 8260D SIM
Ethyl Benzene	EPA 8260D EPA 8021B	EPA 8260D EPA 8021B
Freon 113	EPA 8260D	EPA 8260D
2-Hexanone	EPA 8260D	EPA 8260D
Hexachlorobutadiene	EPA 8260D	EPA 8260D
Isopropylbenzene	EPA 8260D	EPA 8260D
4-Isopropyltoluene	EPA 8260D	EPA 8260D
Methylene chloride	EPA 8260D	EPA 8260D
4-Methyl-2-pentanone	EPA 8260D	EPA 8260D
Methyl tert-butyl ether	EPA 8260D	EPA 8260D
Naphthalene	EPA 8260D	EPA 8260D
n-Propylbenzene	EPA 8260D	EPA 8260D
Styrene	EPA 8260D	EPA 8260D
1,1,1,2-Tetrachloroethane	EPA 8260D	EPA 8260D
1,1,2,2-Tetrachloroethane	EPA 8260D	EPA 8260D
Tetrachloroethene	EPA 8260D	EPA 8260D
Toluene	EPA 8260D EPA 8021B	EPA 8260D EPA 8021B
1,2,3-Trichlorobenzene	EPA 8260D	EPA 8260D
1,2,4-Trichlorobenzene	EPA 8260D	EPA 8260D
1,1,1-Trichloroethane	EPA 8260D	EPA 8260D
1,1,2-Trichloroethane	EPA 8260D	EPA 8260D

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
Trichloroethene	EPA 8260D	EPA 8260D
Trichlorofluoromethane	EPA 8260D	EPA 8260D
1,2,3-Trichloropropane	EPA 8260D EPA 8260D SIM	EPA 8260D EPA 8260D SIM
1,2,4-Trimethylbenzene	EPA 8260D	EPA 8260D
1,3,5-Trimethylbenzene	EPA 8260D	EPA 8260D
Vinyl Acetate	EPA 8260D	EPA 8260D
Vinyl Chloride	EPA 8260D	EPA 8260D
Xylenes, Total	EPA 8260D EPA 8021B	EPA 8260D EPA 8021B
1,2-Xylene (O-Xylene)	EPA 8260D EPA 8021B	EPA 8260D EPA 8021B
1,3-Xylene & 1,4-Xylene (M+P-Xylene)	EPA 8260D EPA 8021B	EPA 8260D EPA 8021B
Toxicity Characteristic Leaching Procedure (ZHE)	EPA 1311	EPA 1311
Volatiles Preparation Methods	EPA 5030B	EPA 5035A
Total Petroleum Hydrocarbons (TPH)		
Gasoline Range Organics	EPA 8015C AK 101 (AK State Method)	EPA 8015C AK 101 (AK State Method)
GRO Preparation Methods	EPA 5030B	EPA 5035A
Diesel Range Organics	EPA 8015C AK 102 (AK State Method)	EPA 8015C AK 102 (AK State Method)
Residual Range Organics	EPA 8015C AK 103 (AK State Method)	EPA 8015C AK 103 (AK State Method)
DRO/RRO Preparation Methods	EPA 3520C Modified EPA 3630C	EPA 3550C, EPA 3630C
Extractable Organics (Semi-volatiles)		
Acenaphthene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Acenaphthylene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Aniline	EPA 8270D	EPA 8270D
Anthracene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Azobenzene	EPA 8270D	EPA 8270D
Benzoic Acid	EPA 8270D	EPA 8270D
Benzo(a)anthracene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Benzo(b)fluoranthene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Benzo(k)fluoranthene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Benzo(ghi)perylene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
Benzo(a)pyrene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Benzyl Alcohol	EPA 8270D	EPA 8270D
Bis (2-chloroethoxy) Methane	EPA 8270D	EPA 8270D
Bis (2-chloroethyl) Ether	EPA 8270D	EPA 8270D
Bis (2-chloroisopropyl) Ether	EPA 8270D	EPA 8270D
Bis (2-ethylhexyl) Phthalate	EPA 8270D	EPA 8270D
4-bromophenylphenyl Ether	EPA 8270D	EPA 8270D
Butyl Benzyl Phthalate	EPA 8270D	EPA 8270D
Carbazole	EPA 8270D	EPA 8270D
4-Chloroaniline	EPA 8270D	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D	EPA 8270D
1-Chloronaphthalene	EPA 8270D	EPA 8270D
2-Chloronaphthalene	EPA 8270D	EPA 8270D
2-Chlorophenol	EPA 8270D	EPA 8270D
4-Chlorophenyl Phenyl Ether	EPA 8270D	EPA 8270D
Chrysene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Dibenzo(a,h)anthracene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Dibenzofuran	EPA 8270D	EPA 8270D
1,2-Dichlorobenzene	EPA 8270D	EPA 8270D
1,3-Dichlorobenzene	EPA 8270D	EPA 8270D
1,4-Dichlorobenzene	EPA 8270D	EPA 8270D
3,3'-Dichlorobenzidine	EPA 8270D	EPA 8270D
2,4-Dichlorophenol	EPA 8270D	EPA 8270D
2,6-Dichlorophenol	EPA 8270D	EPA 8270D
Diethyl Phthalate	EPA 8270D	EPA 8270D
2,4-Dimethylphenol	EPA 8270D	EPA 8270D
Dimethyl Phthalate	EPA 8270D	EPA 8270D
di-n-Butyl Phthalate	EPA 8270D	EPA 8270D
di-n-Octyl Phthalate	----------	EPA 8270D
2,4-Dinitrophenol	EPA 8270D	EPA 8270D
2,4-Dinitrotoluene	EPA 8270D	EPA 8270D
2,6-Dinitrotoluene	EPA 8270D	EPA 8270D
Fluoranthene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Fluorene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Hexachlorobenzene	EPA 8270D	EPA 8270D
Hexachlorobutadiene	EPA 8270D	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D	EPA 8270D
Hexachloroethane	EPA 8270D	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Isophorone	EPA 8270D	EPA 8270D

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
1-Methylnaphthalene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
2-Methylnaphthalene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
2-Methyl-4,6-dinitrophenol	EPA 8270D	EPA 8270D
2-Methylphenol (As O cresol)	EPA 8270D	EPA 8270D
3 & 4-Methylphenol (As P & M cresol)	EPA 8270D	EPA 8270D
Naphthalene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
2-Nitroaniline	EPA 8270D	EPA 8270D
3-Nitroaniline	EPA 8270D	EPA 8270D
4-Nitroaniline	EPA 8270D	EPA 8270D
Nitrobenzene	EPA 8270D	EPA 8270D
2-Nitrophenol	EPA 8270D	EPA 8270D
4-Nitrophenol	EPA 8270D	EPA 8270D
n-Nitrosodimethylamine	EPA 8270D	EPA 8270D
n-Nitrosodi-n-propylamine	EPA 8270D	EPA 8270D
n-Nitrosodiphenylamine	EPA 8270D	EPA 8270D
Pentachlorophenol	EPA 8270D	EPA 8270D
Phenanthrene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Phenol	EPA 8270D	EPA 8270D
Pyrene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Pyridine	EPA 8270D	EPA 8270D
1,2,4-Trichlorobenzene	EPA 8270D	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D	EPA 8270D
Pesticides/Herbicides/PCBs		
Aldrin	EPA 8270D SIM	EPA 8270D SIM
alpha-BHC	EPA 8270D SIM	EPA 8270D SIM
alpha-Chlordane	EPA 8270D SIM	EPA 8270D SIM
beta-BHC	EPA 8270D SIM	EPA 8270D SIM
delta-BHC	EPA 8270D SIM	EPA 8270D SIM
gamma-BHC	EPA 8270D SIM	EPA 8270D SIM
gamma-Chlordane	EPA 8270D SIM	EPA 8270D SIM
Chlordane (technical)	EPA 8270D SIM	EPA 8270D SIM
4,4’-DDD	EPA 8270D SIM	EPA 8270D SIM
4,4’-DDE	EPA 8270D SIM	EPA 8270D SIM
4,4’-DDT	EPA 8270D SIM	EPA 8270D SIM
Dieldrin	EPA 8270D SIM	EPA 8270D SIM
Endosulfan I	EPA 8270D SIM	EPA 8270D SIM
Endosulfan II	EPA 8270D SIM	EPA 8270D SIM
Endosulfan Sulfate	EPA 8270D SIM	EPA 8270D SIM
Endrin	EPA 8270D SIM	EPA 8270D SIM

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
Endrin Aldehyde	EPA 8270D SIM	EPA 8270D SIM
Endrin Ketone	EPA 8270D SIM	EPA 8270D SIM
Heptachlor	EPA 8270D SIM	EPA 8270D SIM
Heptachlor Epoxide	EPA 8270D SIM	EPA 8270D SIM
Methoxychlor	EPA 8270D SIM	EPA 8270D SIM
PCB-1016 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1221 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1232 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1242 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1248 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1254 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1260 (Aroclor)	EPA 8082A	EPA 8082A
Semivolatile Extraction Methods	EPA 3520C Modified EPA 3535A	EPA 3550C EPA 3665A
Toxaphene	EPA 8270D SIM	EPA 8270D SIM
Toxicity Characteristic Leaching Procedure	EPA 1311	EPA 1311
Hazardous Waste Characteristics		
Corrosivity	EPA 9040C	EPA 9045D
Ignitability	EPA 1020B	----------

Accredited Laboratory

A2LA has accredited

SGS NORTH AMERICA INC. - ALASKA DIVISION

Anchorage, AK

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2017, the 2009 TNI Environmental Testing Laboratory Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.4 of the DoD/DOE Quality System Manual for Environmental Laboratories (QSM), accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated *April 2017*).

Presented this 9th day of December 2021.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2944.01
Valid to December 31, 2023

For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

APPENDIX C
FIELD STANDARD OPERATING PROCEDURES

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STANDARD OPERATING PROCEDURE

BE-SOP-01

Logbook Documentation and Field Notes

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) describes the criteria for the content and format of field logbooks and data sheets. This SOP should be used to direct field personnel in the requirements for recording information in logbooks to ensure that field activities are properly documented.

Adequate documentation is necessary to describe the work performed. Attention to detail is vital as field logbooks are useful in the reporting process as well as in administrative and judicial proceedings. As a result, it is important that documentation be factual, complete, accurate, consistent, and clear.

2.0 PERSONNEL RESPONSIBILITIES

All site personnel who make logbook entries are responsible for maintaining the required documentation. The Field Team Lead will inform personnel as to who will be responsible for field notebook and form entries, care, and maintenance.

3.0 FIELD NOTEBOOK PROCEDURE

Field logbooks are bound, sequentially paginated, weatherproof notebooks used to record daily field activities. All notes will be entered in permanent ink.

3.1 FRONT COVER

The front cover of each logbook must include the following information:

- Project name and Site ID
- Project Month(s) and Year
- Name(s) of field logbook author(s)

3.2 PROJECT CONTACT INFORMATION

Include project contact information on the inside front cover or first page of the logbook. Contact information includes names and phone numbers of subcontractors, project assistants, field team members, and emergency numbers from the Accident Prevention Plan and/or Site-Specific Health and Safety Plan.

3.3 DAILY ENTRIES

Logbook entries should abide by the following guidelines:

- Pages should never be removed from the logbook.
- All information must be printed legibly and in permanent ink.
- Entries should be written using objective and factual language and should be made in chronological order.
- Entries will be made on subsequent lines such that no blank lines exist on any page.
- If any space remains on the bottom of the last page of field entries at the conclusion of the day's entries, a diagonal line will be drawn and signed to obscure any additional entries on that page.
- If corrections are necessary, a single line may be drawn through the original entry. The corrected information may then be added and should be initialized and dated.

Each logbook page should include the following:

- Job name or number, date, and personnel at the top of each page.
- Date and signature at the bottom of each page, with a line through any remaining blank lines.

The daily standard logbook entries will include the following:

- The project name, Site ID, and date
- Daily objectives
- Relevant weather conditions and changing weather that may impact site conditions
- Full names and affiliations of onsite personnel and visitors including time of arrival and departure from the site
- Date and time of each activity (including work start/stop times); time will be based on the 24-hour clock (i.e., 2100 instead of 9 pm)
- Location of activity
- Pertinent observations and comments
- Level of Personal Protective Equipment
- Field measurements and screening results not included on field data sheets
- Daily equipment calibrations, checks, and maintenance not included on field data sheets
- Deviations from the project-specific Work Plan
- Site sketches with reference to north direction (with approximate scale or "not to scale" noted), sample and field screening locations and depths, and on-site groundwater flow direction (if known)
- Survey and/or location of any sampling points, including swing-tie measurements
- A description of each sampled collected including date, time, sampler(s), sample ID, media, sample location, sample depth below ground surface, and whether any associated QC (dup/MS/MSD) samples were collected. If not recorded on field data sheets, container(s), preservatives, and analyses will also be recorded
- Sample shipments (when, what, destination)
- Waste tracking and inspections (accumulation start, quantities, staging area and containers conditions, and transporter and destination, if applicable)
- References to relevant data sheets and documentation preserved outside of the logbook such as

groundwater sampling data sheets, soil boring logs, and calibration logs. Do not duplicate information from the referenced sheets in the logbook.

- Decontamination times and methods
- Daily summary of activities (e.g., number of samples collected)
- Date and signature at the end of each daily entry, with a line through any remaining blank lines at the bottom of the final page of the day.

Correct erroneous log book entries with a single line through the error. Do not erase incorrect information. Date and initial revised entries.

3.4 FIELD DATA SHEETS

All other supportive unbound data documentation that is a part of the field records should be maintained as part of the field forms. These records should be recorded in weatherproof ink and on weatherproof paper as necessary. Once back into the office, the unbound records will be scanned to create an electronic record to ensure document preservation. Correct erroneous data sheet entries with a single line through the error. Do not erase incorrect information. Date and initial revised entries.

3.5 ELECTRONIC DATA SHEETS

Electronic data documents include photographs, GPS and survey data, etc. All electronic data that are part of the field records will be downloaded to a designated location and maintained for project use. Take care when downloading, storing, and managing data. Naming conventions (according to the project-specific Work Plan) should be used to indicate the project, date, and other relevant information to ensure accurate use.

3.6 DOCUMENT CONTROL

At the conclusion of a task or project, all field documentation should be submitted to the Project Administrator for record retention. All original documents should be kept in the project file.

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STANDARD OPERATING PROCEDURE

BE-SOP-02

Sample Chain-of-Custody

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the guidelines for sample handling and custody and has been generated in accordance with the Alaska Department of Environmental Conservation (ADEC) *Field Sampling Guidance* (January 2022). This SOP will be used to direct field personnel in sample chain-of-custody (COC) management. The purpose of the COC is to demonstrate accountability and document sample integrity from the time of sample collection until sample analysis by the laboratory.

2.0 COC ELEMENTS

The elements of a COC include the following:

- Sample labels
- Laboratory receipt forms
- Field custody forms (COC form)
- Custody seals
- Inter-laboratory transfer documentation, if applicable

3.0 SAMPLE HANDLING PROCEDURE

The following sections describe sample COC documentation, field custody procedures, sample packaging, custody seals, transfer of custody, and laboratory custody procedures.

3.1 SAMPLE COC DOCUMENTATION

Sample identification documents are carefully prepared so that sample identification and COC are maintained. Sample identification documents include the field logbook, sample labels, custody seals, and COC records.

A sample is in custody if it meets one of the following conditions:

- In an authorized person's physical possession.
- In an authorized person's view after being in possession.
- In an authorized person's possession and then secured (locked up).
- Kept in a secured area that is restricted to authorized personnel.

3.2 FIELD CUSTODY PROCEDURES

The following procedures are used by field personnel:

- The sample collector is personally responsible for the care and custody of samples collected until they are properly transferred to another company representative or relinquished to the laboratory.
- The sample collector records sample data (time of collection, sample number, analytical requirements, and matrix) in the field logbook and/or on the appropriate field form.
- Sample labels are completed for each sample, using weatherproof ink.

3.3 CHAIN-OF-CUSTODY RECORD

The COC record is fully completed prior to sample shipment. When possible, an electronic COC record should be used. Required information on the COC includes the following:

- Client (contractor name)
- Reporting Information (Chemist name and contact information)
- Project Name
- Invoice information
- PO Number
- COC number
- Cooler ID
- Page number
- NPDL number
- Field Sample ID
- Location ID
- Collection date
- Collection time (in 24-hour format)
- Sampler initials
- Quantity (number of containers)
- Container types (VOA, amber, 40 mL, etc.)
- Container volumes
- Preservative
- Sample matrix (soil, water, other)
- Requested laboratory analysis methods required for each jar
- Quality control (trip blanks and MS/MSD)
- Turn-around-time (TAT)
- Notes
- Special instructions

3.4 SAMPLE PACKAGING

Samples are labeled and packaged according to the *Labeling, Packaging, and Shipping Samples* SOP (BE-SOP-03). The COC record accompanies all sample shipments. Two COC records are prepared for each shipment. One COC record is placed in a re-sealable plastic bag with the bag sealed shut to prevent water intrusion from moisture in the cooler, and the bag is taped inside the cooler lid. The duplicate or electronic copy of the COC record is retained by the sampler and provided to the Project Chemist and other sample coordinators. Airway bills are retained with the COC record and provided to the Project Chemist, so

sample pickup can be coordinated with the laboratory. Airway bills must be scanned and placed in a designated location, typically the "Field" folder, and maintained for project use.

3.5 CUSTODY SEALS

Custody seals are preprinted, adhesive-backed seals with security slots designed to break if the seals are disturbed. Seals are signed and dated at the time of use. Sample shipping containers (coolers) are sealed in as many places as necessary to ensure that the container cannot be opened without tearing the custody seals. Typically, one custody seal is placed along the front corner of the cooler, and a second is placed along the opposite back corner of the cooler. Clear tape is placed over the seals to ensure that seals are not accidentally broken during shipment. If the custody seal was broken at some point during transport, the reason for breaking the seal, condition of the container contents, the cooler temperature, and anything added to or removed from the container must be documented on the COC form. The container must then be sealed with a new custody seal.

If a sample handler transports the samples to the laboratory without sample shipment, custody seals are not required.

3.6 TRANSFER OF CUSTODY

When transferring the possession of samples from the field sampler to a transporter or to the laboratory, the sampler must sign, date, and note the time as "relinquished by" on the COC record. The receiver also signs, dates, and notes the time as "received by" on the COC record; however, when samples are transported by a common commercial carrier, such as Alaska Airlines or Federal Express, the carrier does not sign the COC record; rather, the COC record is signed by the sampler as "relinquished by" prior to closing the sample coolers for shipment and relinquishing them to the commercial carrier.

3.7 LABORATORY CUSTODY PROCEDURES

A designated sample custodian accepts custody of the shipped samples and verifies that the sample identification number matches the COC record. The laboratory completes a cooler receipt form when samples are received. The cooler receipt form documents any discrepancies identified between the sample labels and COC, cooler temperature(s), sample preservation, and sample integrity. Cooler receipt information, including a signed COC, custody seals, and a completed cooler receipt form, are provided to the Project Chemist and emailed to receipt.cooler@usace.army.mil within 24 hours of cooler receipt.

4.0 REFERENCES

ADEC. 2022 (January). *Field Sampling Guidance*.

ATTACHMENTS

Attachment A Chain-of-Custody Form

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Chain-of-Custody Report

Collection Organization: **Chain-of-Custody:** **Cooler ID:** **NPDL Number:**

Project Number: **Laboratory:** **Bill To:** **Report To:**

COC Sample ID	Loc ID	Collection Date	Collection Time	Sampler	Quantity	Container Type	Volume	Preservative	Matrix	Analyses Requested Group	QC	TAT	Notes:

Special Instructions:

Relinquish By: Relinquish By:

Signature/Printed Name Date/Time Signature/Printed Name Date/Time

Received By: Received By:

Signature/Printed Name Date/Time Signature/Printed Name Date/Time

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STANDARD OPERATING PROCEDURE

BE-SOP-03

Labeling, Packaging, and Shipping Samples

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) will be used to direct field personnel in the techniques and requirements for labeling, packaging, and shipping samples from the field to the laboratory for analysis.

2.0 MATERIALS

The term "environmental sample" refers to any sample that has less than reportable quantities of any hazardous constituents according to Department of Transportation (DOT) 49 CFR - Section 172. Equipment required for labeling, packaging, and shipping environmental samples includes:

- Weatherproof labels for sample containers
- Coolers
- Gel ice packs
- Sorbent pads
- Contractor-grade plastic bags
- Bubble wrap and/or foam inserts
- Plastic zip-top bags, quart and gallon
- Clear tape
- Strapping tape
- Cooler labels: "keep cool/refrigerate/do not freeze," "this end up," "fragile," dangerous goods, excepted quantities, shipping address, etc.

3.0 PROCEDURES

This section describes the procedures for labeling, packaging, and shipping collected samples.

3.1 LABELING

Samples must be labeled using nomenclature defined in the project-specific work plan. All sample labels must be weatherproof and contain the following information:

- Project or project number
- Sampler name or initials
- Sample identification
- Sample date and time (in 24-hour format)
- Laboratory analysis methods required for sample jar
- Preservatives added to sample jar

Adhesive sample labels are placed directly on the sample containers. If the labels do not adequately adhere due to moisture, secure the label by placing clear packaging tape over the label. Sample containers that are weighed by the laboratory prior to use **should not** have any additional labels or tape placed on the container as it affects the weight. For those containers, use the label that is already provided on the jar. Only one label should be placed on each sample container.

3.2 PACKAGING

When packing sample containers for shipment, the steps below must be followed.

1. Choose a cooler with structural integrity to withstand shipment. Secure and tape the drain plug with duct tape.
2. Be sure that container lids are tight and will not leak. Make sure not to over-tighten and/or break the cap.
3. Ensure that the sample labels are intact, fully completed with the correct information, and that the sample identification exactly matches the chain-of-custody record.
4. Place sample containers in bubble wrap, bubble bags, in their original boxes, or in re-sealable bags with sorbent pads, depending on the type of container. Wrap and package containers sufficiently to prevent cross contamination and ensure that containers remain intact during shipment (bubble wrap and plastic zip-top bags).
5. Place a layer of frozen gel ice packs, along the bottom of the cooler. Cover the ice packs with a layer of bubble wrap and then place a sorbent pad over the bubble wrap.
6. Line the cooler with a contractor-grade plastic bag.
7. Place the containers inside the contractor-grade plastic bag with caps up.
8. Ensure that a temperature blank is included in each cooler. The temperature blank should be placed at the same level and next to the samples, preferably in the center of the cooler.
9. If the cooler contains volatile samples, ensure that a trip blank is included.
10. Fill excess space between sample containers with additional bubble wrap or gel ice.
11. Tape the top of the contractor-grade plastic bag shut once all sample containers, trip blanks, and the temp blank are inside.
12. Place another layer of bubble wrap along the top of the cooler, and if possible, place a layer of gel ice packs along the top of the cooler. **Use sufficient ice in packaging to ensure that samples are received by the laboratory at the proper temperature of 0 to 6°C. Note that partially melted or soft gel ice packs should not be used to pack coolers for transport. A minimum of 8 frozen gel ice packs should be used to maintain sample temperature during transit for 24 hours.**
13. Fill remaining headspace with additional packing material.
14. Place the completed Chain-of-Custody record for the laboratory into a plastic zip-top bag, tape the bag to the inner side of the cooler's lid, and then close the cooler.
15. Conduct a "shake test" by gently shaking the cooler to determine if the containers are shifting in the cooler. If so, add additional packing material until there are no sounds of shifting when shaken.
16. Wrap strapping tape around each end of the cooler two times to secure the lid. Place completed custody seals on the front and back of the cooler so that the cooler cannot be opened without breaking the seals. Place clear tape over custody seals.

17. Attach an address label containing the name and address of the shipper to the top of the cooler. Attach other markings such as "Refrigerate" or "Keep Cool," "Do Not Freeze," and "Fragile." For samples with liquid (including preserved soil samples), place "up arrow" stickers on opposite sides of the cooler pointing in the same direction as the containers containing liquids.

3.3 SAMPLE SHIPPING

Environmental samples are shipped as non-hazardous materials unless the samples meet the established DOT criteria for a "hazardous material" or the International Air Transport Association (IATA)/International Civil Aviation Organization (ICAO) air definition of "dangerous goods." If the samples meet criteria for hazardous materials or dangerous goods, then DOT and IATA/ICAO regulations must be followed, which includes having qualified personnel send shipments.

Samples shipped as "Dangerous Goods in Excepted Quantities" must have the appropriate labelling and be declared as dangerous goods to the shipping carrier; however, a dangerous goods "candy-striped" form and Notification to Caption (NOTOC) are not required (IATA 2020).

3.3.1 Soil Sample Shipments

Soil samples preserved with methanol, and any excess methanol vials, must be shipped as "Dangerous Goods in Excepted Quantities" per the IATA regulations. The volume for excepted quantities of methanol is 30 mL per container and 500 mL per cooler. The hazard class number is 3, flammable liquid, UN 1230. Sample jars with methanol in excess of 30 mL and coolers with methanol in excess of 500 mL require shipment as "Dangerous Goods" and require the completion of a "candy-striped" form.

3.3.2 Water Sample Shipments

Water samples preserved with hydrochloric acid or other insignificant amounts of preservative are not shipped as dangerous goods once filled; however, pre-preserved sample containers with preservative and no water added must be shipped as "Dangerous Goods in Excepted Quantities" per IATA regulations. The volume for excepted quantities of hydrochloric acid or nitric acid is 30 mL per container and 500 mL per cooler, respectively. The hazard class number is 8, corrosive. Sample jars with hydrochloric acid or nitric acid in excess of 30 mL and coolers with hydrochloric acid or nitric acid in excess of 500 mL require shipment as "Dangerous Goods" and require the completion of a "candy-striped" form.

Upon shipping samples, notify the laboratory contact that samples have been shipped and provide the airway bill number.

4.0 REFERENCES

IATA. (2020). *Dangerous Goods Regulations (DGR) Limited/Excepted Quantities Labels.*

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STANDARD OPERATING PROCEDURE

BE-SOP-04

Quality Control Samples

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to direct field personnel in the requirements necessary for collecting field quality control (QC) samples from certain matrixes. Field QC samples are collected to ensure the reliability and validity of field and laboratory data.

2.0 SAMPLING PROCEDURE

The following sections describe different QC sample types that may be required in project-specific work plans.

2.1 FIELD DUPLICATE

A field duplicate is collected to evaluate whether sample matrix heterogeneity, contaminant distribution, or sample collection methods affect analytical precision. The field sampler ensures that primary and duplicate samples are effectively identical by collecting the samples from the same location, at the same time, with the same techniques, and from the same matrix. Non-volatile samples should be homogenized in a metal bowl or sealable zip-top bag prior to sample collection. Volatile samples should not be homogenized to minimize loss of volatile constituents; however, an effort should be made to collect samples from the same matrix and part of the sample interval.

At a minimum, one blind field duplicate should be collected per day and per 10 samples for each analytical method and matrix for offsite laboratory analysis. In some cases, such as when only one monitoring well per day can be sampled because of low yielding groundwater, it is not feasible to achieve the one field duplicate per day requirement. If anticipated prior to conducting project work, these site-specific deviations should be included in the site-specific work plan. If multiple sample coolers are shipped together, an effort should be made during sample packaging to include a duplicate in each cooler.

Field duplicates are submitted as blind samples with a unique sample number and collection time to the approved laboratory for analysis (Alaska Department of Environmental Conservation [ADEC] 2022). A duplicate sample collection time of one hour before the primary sample time is recommended to ensure there are no holding time issues.

2.2 MATRIX SPIKE AND MATRIX SPIKE DUPLICATE (MS/MSD)

MS/MSD samples are collected to evaluate the precision and accuracy of laboratory procedures in the project sample matrix. The MS/MSD compound is added at the laboratory. This sample is collected at the same time as the primary sample using the same procedure, equipment, and type of container. The

MS/MSD sample should be labeled the same as the primary sample with a matching sample identification and time denoted on the chain-of-custody (CoC) form to ensure that the project MS/MSD pair is used in the laboratory report. The MS/MSD should be noted in the QC column of the CoC. At a minimum, the frequency of MS/MSD samples collected is one for each analytical batch. Note that the analytical laboratory often batches samples in the same cooler together for shipments containing multiple coolers, so an effort should be made during sample packaging to include an MS/MSD in each cooler. The MS/MSD evaluation process is specified in the QAPP.

2.3 TEMPERATURE BLANK

A temperature blank must be included in each sample cooler. A temperature blank is measured by the laboratory to verify and document that the cooler temperature is received between 0 and 6 degrees Celsius (°C). Temperature blanks consist of plastic bottles filled with water, typically prepared by the laboratory. Once shipments are received by the laboratory, the temperature is recorded on the CoC to document that preservation requirements were met.

2.4 TRIP BLANKS

Trip blanks must accompany volatile samples, including GRO, BTEX, and VOCs. Trip blanks are prepared by the laboratory and are used to establish that the sample has not been contaminated by external sources during sample bottle transport to and from the field. Trip blanks are samples of reagent-grade water, properly preserved in a controlled environment by the laboratory prior to field mobilization. Trip blanks are kept with the sample containers throughout the sampling process and returned to the laboratory with the analytical samples. One trip blank must accompany each cooler containing volatile samples. All trip blanks must be labeled and included on the CoC. Trip blank sample times will be recorded as 0800 on the CoC. The trip blank evaluation process is specified in the QAPP.

2.5 EQUIPMENT BLANKS

Equipment blanks may be used to evaluate the effectiveness of a decontamination procedure. The equipment rinsate blank is collected by pouring or pumping deionized water onto or into the sampling equipment after the equipment has been decontaminated, and then collecting the rinsate water for analysis of an analytical suite identical to that performed for the associated sample(s). The required equipment rinsate blank collection frequency and evaluation process are specified in the QAPP. Decontamination procedures must be performed according to the *Equipment Decontamination* SOP (BE-SOP-14).

3.0 REFERENCES

ADEC. 2022 (January). *Field Sampling Guidance*.

STANDARD OPERATING PROCEDURE

BE-SOP-05

Soil Logging

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes a standard process for classifying and logging soils recovered using a drill rig or other mechanized equipment.

2.0 MATERIALS

Field materials include, but are not limited to the following:

- Clipboard
- Description aids (Munsell color & Unified Soil Classification charts)
- Soil Boring Logs
- Permanent ink pen
- Plastic folding table
- Core cutter with extra blades
- Tape measure
- Duct tape
- White board with erasable markers
- Camera
- Nitrile gloves
- Hand tools (trowels, spoons, rock hammer, etc.)
- Hand broom and dustpan
- 5-gallon bucket

3.0 PROCEDURES

Soil lithology will be determined and documented in general accordance with standards established by the Unified Soil Classification System (USCS), as described in *American Society for Testing and Materials* (ASTM) Method D2488 (Attachment A). In general, the process involves visual observation of the soils and documentation on soil boring logs (Attachment B). All fields on the soil boring log will be used or an "NA" will be inserted to indicate a field that is not applicable.

3.1 PHOTOGRAPH

Upon opening the Macro-core, dual tube, or split spoon sampler, photograph the sampler. Ensure that the tape measure indicating sample recovery is visible in the photograph. Use a whiteboard with erasable markers to indicate important information about each sample, including:

- LocID

- Depth range
- Top and bottom of sample
- Date

3.2 SOIL BORING LOG

General information included on each soil boring log must include:

- Project
- Project number
- Client
- Boring No.
- Address, city, and state
- Drilling contracting
- Drill crew
- Logged by
- The start, completion, and backfill date and method
- Drilling method and equipment used, including borehole dimeter
- Groundwater depth
- Elevation
- Total depth of boring

Specific information included on each log must include:

- Sample interval
- Inches driven
- Inches recovered
- PID (ppm)
- Time
- Soil description (soil name, USCS group symbol, color, relative density or consistency, plasticity (silt and clay only), moisture content, secondary grain size, odor, additional facts)
- Sample information (sample ID, time, analytes, number and type of containers, preservatives, QC – Duplicate or MS/MSD, for volatile containers tare weights and total container weights, methanol lot numbers)
- Blow counts for split spoon sampling (the number of hammer blows to push the split spoon 6, 12, 18, and 24 inches)
- Total boring depth or refusal depth

3.3 SOIL DESCRIPTION

Since samples are collected mostly for environmental sampling and contaminant characterization purposes, strict adherence to the USCS may not be required, unless specified in the project-specific Work Plan. The following characteristics should be described in the soil description:

Soil name and USCS Group Symbol

The first step in soil logging is determining if the soil is primarily coarse-grained or fine-grained. Coarse-grained deposits consist of gravel and sand, while fine-grained deposits consist of silt and clay. For coarse-grained deposits, the second step is determining the sand to gravel ratio. Sand particle sizes are classified as fine (0.07 mm to 0.43 mm), medium (0.43 mm to 2.0 mm), and coarse (2.0 mm to 5.0 mm). Gravel is defined as fine (0.5 cm to 1.9 cm) and coarse (1.9 cm to 7.6 cm). Once the ratio of sand and gravel is determined, the estimated percentages are used to select a soil name and USCS group symbol using the USCS classification system chart (refer to Attachment A). For fine-grained deposits, the plasticity must be evaluated before selecting a soil name and USCS group symbol. Silts range from non-plastic to low plasticity, lean clay ranges from low plasticity to medium plasticity, and fat clay is high plasticity.

Color

Color is important in identifying organic soils and materials from similar geologic units. The material's representative color and any layers with different colors should be described on the soil boring log.

Relative density or consistency

Density is used to describe coarse-grained deposits (sand and gravel). Soil density is described by the following criteria:

- Very loose
- Loose
- Medium dense
- Dense
- Very dense

Consistency is used to describe fine-grained deposits (silt and clay). Soil consistency is described using the following criteria:

- Very soft – thumb will penetrate more than 1-inch
- Soft – thumb will penetrate soil approximately 1-inch
- Medium – thumb will indent soil approximately 0.5-inch
- Stiff – thumb will indent soil approximately 0.25-inch
- Very stiff – thumb will indent soil approximately 0.125-inch
- Hard – thumb will not indent soil but can be indented by thumbnail

Plasticity

Plasticity is a characteristic of fine-grained soils (silt and clay). Soil that passes through a No. 200 sieve and is non-plastic or low-plasticity is silt. Soil that passes through a No. 200 sieve, is plastic over a range of water contents, and has strength when dry is clay. Plasticity should be classified according to the following criteria:

- Non-plastic – A 3 mm or 0.125-inch thread cannot be rolled at any water content
- Low – thread can barely be rolled
- Medium – thread is easy to roll to the plastic limit, but the thread cannot be rerolled
- High – takes a long time rolling to reach plastic limit and the thread can be rerolled multiple times

Moisture content

The relative soil moisture content is important for determining water table depth and if zones of perched water are present. Soil moisture is described by the following terminology:

- Dry – moisture absent, dusty, dry to the touch
- Moist – damp but no visible water
- Wet – visible water (usually soil below water table)

Secondary and Tertiary Components

The estimated percentages of secondary and tertiary soil components are described using the following terminology:

- Trace <5%
- Little 6% to 15%
- Few 16% to 30%
- Some 31% to 49%

Odor

Note any odors observed, including organic or unusual odors (petroleum hydrocarbon).

Additional Descriptors

Note any unusual characteristics, such as the presence of roots and debris. Other descriptors that are commonly used include:

Angularity

Angularity is used to describe coarse-grained soils only (coarse sand, gravel, cobbles, and boulders). The following descriptors are used to describe angularity:

- Angular – sharp edges and plane sides
- Subangular – Similar to angular got with rounded edges
- Subrounded – have plane sides with well-rounded corners sand edges
- Rounded- Particles have smooth sides and no edges

Lensed

The lensed descriptor indicates that the soil includes small pockets of different soils.

Stratified

The stratified descriptor indicates that there are alternating layers of different materials or colors.

3.4 EXAMPLES

Poorly graded sand with gravel (SP), fine sand, brown, loose, moist, few gravel.

Well graded sand with gravel (SW), fine to coarse sand, gray, medium dense, wet, some gravel.

Poorly graded gravel with sand (GP), subrounded fine gravel, gray, dense, moist, few sand.

Silty sand (SM), fine to medium sand, brown, loose.

Sandy silt (ML), gray, stiff, moist, trace subangular gravel, slight petroleum odor.

Silt (ML), brown, medium, moist, trace fine sand.

4.0 REFERENCES

ASTM. 2017 (July). *Standard Practice for Description and Identification of Soils Visual-Manual Procedure.* D2488. West Conshocken, Pennsylvania.

ATTACHMENTS

Attachment A Standard Terminology for Soil Descriptions
Attachment B Soil Boring Log

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Standard Terminology for Soil Descriptions

SOIL DESCRIPTION FORMAT

USCS SOIL NAME: angularity (coarse sand or greater), soil description (order of abundance), cobbles and boulders, *Munsell color (optional)*, color, density, moisture, *odor strength and type (optional*), *structure (optional), other comments (optional*), USCS symbol, *geologic environment (optional).*

EXAMPLES

WELL-GRADED GRAVELLY SAND: angular coarse sand, some gravel, trace silt/clay, 3-5 inch cobbles, 5Y 3/1 gray, very dense, moist, no odor, lensed, with trace fine organics and fine roots, SW, (GLACIAL TILL).

POORLY GRADED GRAVEL: angular fine gravel, some silt/clay, trace sand, 12-18 inch boulders, gray, dense, dry, weak petroleum odor, homogenous, GP.

SILT WITH SAND: silt, with fine to coarse sand, trace gravel, 5Y 3/1, gray, medium dense, wet, ML.

SILT/CLAY: silt, trace sand and gravel, tan, moderate organic odor, hard, wet, laminated, fine organics and roots, ML-CL, (LACUSTRINE).

NOTES:

- Descriptions are in general accordance with ASTM D2488, moisture content and particle abundance descriptors have been modified from the ASTM specification.
- Descriptions may include but are not limited to the information described in this procedure.
- Abundances of gravel, sand, and silt are estimated visually; sieve analysis is not performed typically.
- Blows should be counted when possible (e.g., pounding a split spoon on an auger or mud-rotary drill rig), but direct-push drill rigs typically lack a 140-pound hammer.

PARTICLE ABUNDANCE	
Descriptor	**Criteria**
Some	> 30%
With	15-30%
Little	5-15%
Trace	<5%
Notes: Boulders and cobbles should be listed as present with the range of size in inches.	

GRAIN SIZES	
Component	**Particle Size**
Boulders	>12 inches (30cm)
Cobbles	12 to 3 inches (30 to 7.6 cm)
Gravel	3 inch to #4 sieve (75 to 4.75 mm)
Sand	#4 to #200 sieve (4.75 to 0.075 mm)
Silt/Clay	<#200 sieve(<0.075mm)

MOISTURE CONTENT	
Description	**Criteria**
Dry	Absence of moisture, dusty, dry to the touch
Damp	Slight amount of water
Moist	No visible water, sand will hold together
Wet	Visible free water with effort, glistens
Saturated	Pore space filled (below water table)

SAND AND GRAVEL SIZE		
Description	**Sand Range**	**Gravel Range**
Fine	0.07 to 0.43 mm	0.5 to 1.9 cm
Medium (Sand Only)	0.43 to 2 mm	N/A
Coarse	2 to 5 mm	1.9 to 7.6 cm
Notes: Boulders and cobbles should be listed as present with the range of size in inches.		

RELATIVE DENSITY			
Fine-Grained Soil		**Coarse-Grained Soil**	
Density	**N-Value**	**Density**	**N-Value**
Very Soft	0 to 1	Very Loose	0 to 3
Soft	2 to 4	Loose	4 to 9
Medium Stiff	5 to 8	Medium Dense	10 to 29
Stiff	9 to 15		
Very Stiff	16 to 30	Dense	30 to 49
Hard	>30	Very Dense	>50
Notes: N-Value (Standard Penetration or Blow Count) is considered the number of blows to advance a 2-inch O.D. split-spoon sampler the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches (ASTM D1586). Any variation should be noted. If no blow counts are measured, density should be estimated.			

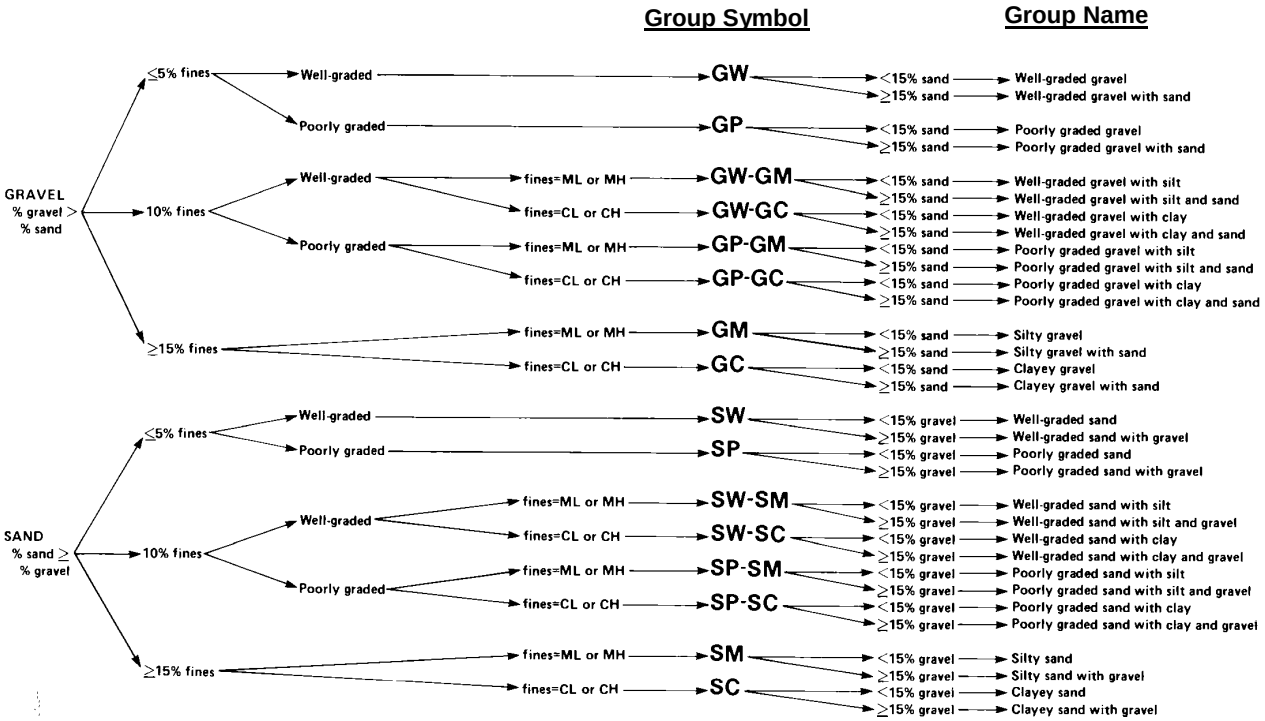
SIMPLIFIED USCS CLASSIFICATION SYSTEMS				
COARSE-GRAINED SOILS <50% passes #200 sieve	GRAVEL <50% coarse fraction passes #4 sieve	GRAVEL <5% pass the #200 sieve	GW	Well-graded gravel, gravel-sand mixture, little or no fines
			GP	Poorly-graded gravel, gravel-sand mixtures, little or no fines
		GRAVEL 5-15%pass the #200 sieve	GW-GM	Well-graded gravel with fines
			GP-GM	Poorly-graded gravel with fines
		GRAVEL >15% pass the #200 sieve	GM	Silty gravel, poorly-graded gravel-sand-silt mixture
			GC	Clayey gravels, poorly-graded gravel-sand-clay mixture
	SANDS >50% coarse fraction passes #4 sieve	SAND <5% pass the #200 sieve	SW	Well-graded sand, gravelly sand, little or no fines
			SP	Poorly-graded sands, gravelly sands, little or no fines
		SAND 5-15% pass the #200 sieve	SW-SM	Well-graded sand with fines
			SP-SM	Poorly-graded sand with fines
		SAND >15% pass the #200 sieve	SM	Silty sand, poorly-graded sand-gravel-silt mixture
			SC	Clayey sand, poorly-graded sand-gravel-clay mixture
FINE-GRAINED SOILS >50% passes #200 sieve	SILT/CLAY Liquid Limit <50%		ML	Inorganic silt & very fine sand, silty or clayey fine sands, clayey silt with slight plasticity
			CL	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay, silty clay, lean clay
			OL	Organic silt & clay of low plasticity
	SILT/CLAY Liquid Limit >50%		MH	Inorganic silt, micaceous or diatomaceous fine sand or silt
			CH	Inorganic clay of high plasticity, fat clay
			OH	Organic silt & clay of medium to high plasticity
HIGHLY ORGANIC SOILS			PT	Peat, humus, swamp soils with high organic content
Notes: If coarse-grained soil contains >10% fines use a dual symbol, e.g. GP-GM. Full USCS chart on page 2.				

Standard Terminology for Soil Descriptions

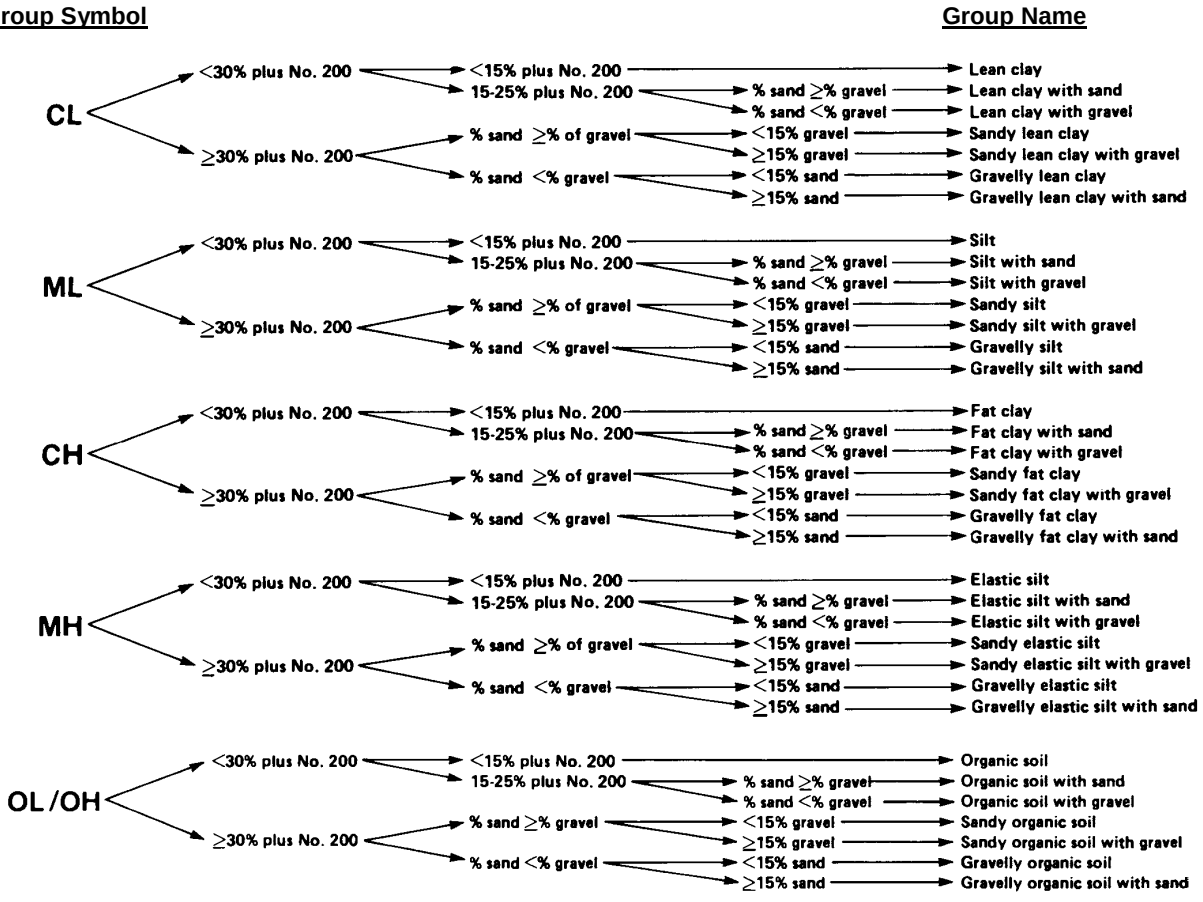
UNIFIED SOIL CLASSIFICATION SYSTEM

(from ASTM D2488)

COARSE-GRAINED SOILS



FINE-GRAINED SOILS



SOIL BORING LOG

Sheet _____ of _____

Project:	Project Number:	Client:	Boring No.
Address, City, State		Drilling Contractor:	
Logged By:	Date: Started:	Drilling Method and Equipment Used:	
	Completed:		
Drill Crew:	Backfilled:		
	Groundwater Depth:	Elevation:	Total Depth of Boring:

Depth (feet)	Sample Interval	Inches Driven	Inches Recovered	PID (ppm)	Time	**Soil Description:** Soil Name, USCS Group Symbol, Color, Relative Density or Consistency, Plasticity, Moisture Content, Secondary Grain Size, Odor, Additional Descriptors	Sample
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							

SOIL BORING LOG

Sheet _____ of _____

Project:	Project Number:	Client:	Boring No.

Depth (feet)	Sample Interval	Inches Driven	Inches Recovered	PID (ppm)	Time	**Soil Description:** Soil Name, USCS Group Symbol, Color, Relative Density or Consistency, Plasticity, Moisture Content, Secondary Grain Size, Odor, Additional Descriptors	Sample
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							

STANDARD OPERATING PROCEDURE

BE-SOP-06

Soil Sampling

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) will be used to guide surface and subsurface soil sample collection. The methods described in this SOP are in accordance with the Alaska Department of Environmental Conservation (ADEC) *Field Sampling Guidance* (ADEC 2022).

2.0 EQUIPMENT AND MATERIALS

Field materials include, but are not limited to the following:

- Clipboard
- Description aids (Munsell color & Unified Soil Classification charts)
- Soil Boring Logs
- Field logbook
- Permanent ink pen
- Plastic folding table
- Core cutter with extra blades
- Tape measure
- Duct tape
- Trash bags
- White board with erasable markers
- Camera
- PPE - nitrile gloves, safety glasses, hard hat, safety vest, safety-toed boots, hearing protection
- Hand auger with extension rods, as necessary
- Shovel, pick ax, pick mattock, or other excavating tools
- Hand tools (trowels, spoons, rock hammer, etc.)
- Stainless steel homogenization bowl
- Hand broom and dustpan
- 5-gallon bucket
- Photoionization Detector for field screening (BE-SOP-15) with isobutylene calibration gas
- Survey stakes, flags, or whiskers to mark sample locations
- Personal Protective Equipment (PPE)
- Zip-top plastic bags
- Scales
- Laboratory-supplied sample jars, preservatives, labels, custody seals, and temperature blanks
- Gel ice
- Decontamination supplies/equipment (Alconox, deionized water, brushes, 5-gallon bucket)

Refer to Attachment A, *Soil Sampling Checklist,* for a more detailed equipment list.

3.0 SOIL SAMPLE TYPES

Soil samples may be collected using a variety of methods and equipment, depending on the depth of the soil profile, type of sample required, contaminants present, and soil classification. Soil samples may be collected from surface or subsurface soils. Under State of Alaska regulation 18 AAC 75.390(127), surface soil is defined as soil that extends no more than two feet below the ground surface (bgs). Subsurface soil is defined under State of Alaska regulation 18 AAC 75.390(123) as soil that is more than two feet bgs. The expected sampling depths and methodologies should be defined in the site-specific work plan. The three most common sampling methodologies include discrete sampling, composite sampling, and incremental sampling methodology. These methods are described in the following subsections.

3.1 DISCRETE SAMPLING

Discrete soil samples are single samples collected from a specific location and depth interval. Sample locations and depths are selected based on information available about the site (previous analytical data, site history and use, field screening results, etc.). Discrete sampling is often used to determine the presence or absence of contamination and identify contaminant boundaries.

3.2 COMPOSITE SAMPLING

Composite samples consist of multiple subsamples that are combined into a single homogenized sample. Typical applications for composite sampling include Toxic Substances Control Act (TSCA) 9-point and 8-point composites for PCBs, and Resource Conservation and Recovery Act (RCRA) waste characterization samples. Subsample aliquots for volatile samples should be placed directly into laboratory-supplied jars and preserved immediately. Non-volatile sample aliquots should be homogenized and then placed into laboratory-supplied jars.

3.3 INCREMENTAL SAMPLING METHODOLOGY

Incremental sampling methodology (ISM) is a systematic composite sampling process designed to reduce data variability. ISM sampling provides a representative sample for a specified volume of soil. Typically, it is used to determine risk associated with contaminant exposure over a specified area. BE-SOP-08 details ISM soil sampling procedures.

4.0 SAMPLE RETRIEVAL AND COLLECTION PROCEDURES

Soil samples may be collected from surface or subsurface soils using drilling equipment, hand tools, shovels, a hand-auger, or heavy-equipment (Excavator). When retrieving samples from the ground, follow these general steps:

1) Ensure that the sampling area is safe for entry and obstacles impeding drill rig access have been removed. If the sample is to be collected from within an excavation, ensure that the excavation meets all criteria for safe entry, or collect the sample directly from the excavator bucket.
2) Use drilling equipment or hand tools to retrieve samples from the desired depth.
3) Don new pair of nitrile gloves.

4) Properly label the sample according to the project-specific Work Plan.
5) Open sampler (Macro-core, split spoon) and place on sampling table.
6) Remove bits of vegetation and large gravel from the sample as these items are not analyzed and reduce the available sample volume for analysis.
7) Take care to prevent cross-contamination and misidentification of samples.
8) Fill volatile sample jars first within two minutes of opening the sampler.
    a) Remove lid on laboratory-supplied pre-tared jar and place jar on scale.
    b) Zero jar on scale.
    c) Use a clean sampling spoon to transfer the required amount of soil (25 g to 50 g depending on lab) from the target depth interval directly from the sample retrieval device (Macro-core, split spoon, auger, window sampler) to the sample jar with the least disturbance possible.
    d) Cover soil with 25 mL of MeOH (50 mL can be used if needed to cover sample but must be noted on CoC and shipped as "dangerous good").
    e) Using clean paper towels, wipe down the jar threads to remove any soil, close the jar with the lid, and wipe the outside of the jar.
9) Fill non-volatile sample jars next.
    a) Using the sample spoon, transfer additional soil from the target depth interval into a re-sealable plastic bag or decontaminated metal bowl to homogenize the soil. Take care to avoid gravel and rocks.
    b) To homogenize the soil, seal the plastic bag and mix and/or stir the soil with the spoon.
    c) Place the homogenized soil directly into the laboratory-supplied jar.
    d) Pack soil into jars until filled.
10) Record sample information (sample ID, time, analytes, number and type of jar, preservatives, QC – Duplicate or MS/MSD, for volatile jars tare weights and total weights, methanol lot numbers) on the soil boring logs and the logbook.
11) Record MeOH lot numbers.
12) Place jars in bubble bags and sealable zip-top bags.
13) Put sample in cooler with gel ice.
14) Make notes on the boring log regarding the soil characterization and geologic features, including any staining or olfactory observations (see BE-SOP-05 for soil logging). Note that samples generally will be collected prior to soil characterization to preserve volatile sample integrity.
15) Decontaminate any non-dedicated, reusable sampling equipment according to Equipment Decontamination procedures (BE-SOP-14), prior to collecting the next sample.

If composite sampling techniques are employed, subsamples are placed into a container constructed of inert material (sealable zip-top bag or metal bowl), homogenized, and transferred to a sample jar.

5.0 REFERENCES

ADEC. 2022 (January). *Field Sampling Guidance.*

ATTACHMENTS

Attachment A Soil Sampling Checklist

Soil/Sediment Sampling Checklist

Prior to Sampling	Initial
Safety Tailgate meeting	
Obtain Permits	
Obtain Sample Containers from Lab	

Soil Sampling	Initial
Ekman or Ponar dredge device	
Spade/Trowel	
Shovel, pick ax, pick mattock	
Hand auger with extension rods	
Survey stakes, flags, or whiskers	
Tape measure	
Samplekits	
gel Ice	
Sample sheets	
DI & Alconox	
Paper towels	
Shovel	
Full socket set (14mm)	
Tool to open well lids	
zip lock bags	
laboratory supplied containers,	
preservatives, labels, custody seals,	
temperature blanks	
Plastic Sheeting	
Coolers	
Trash bags	
Decontamination equipment	
Sample kits	
Gel Ice	
Sample sheets	
DI & Alconox	
Paper towels	
Stainless steel homogenization bucket	
Stainless steel lab spoon or equivalent	
Scale	

PPE/Misc.	Initial
Nitrile gloves	
Shades	
Tailgate form	
Knee pads	
Safety gear (hard hat, gloves, vest, etc.)	
Water	
Laminated site map	
Garbage bags	
PEP/HSE Plan	
Camera	
Whiteboard and marker	

After Sampling	Initial
Address Waste	
Close out permits	
CoC and Samples in cooler	
Download Cameras	
Charge harmony	
QC, chill, and secure samples	
Complete field notes	
Debrief (tailgate form)	

Brice Environmental Services Corportation
Last Updated: 9/23/2015

STANDARD OPERATING PROCEDURE

BE-SOP-09

Groundwater Sample Collection

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) provides methodology for planning groundwater sampling events and collection of groundwater samples.

This SOP was developed in accordance with the following guidance documents:

- *Field Sampling Guidance* (Alaska Department of Environmental Conservation [ADEC], 2022)
- *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers* (U.S. Environmental Protection Agency [EPA] 2002)
- *Low Stress (Low Flow)-Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (EPA 2017).
- *Standard Practice for Low-Flow-Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations* (American Society for Testing and Materials [ASTM] 2018)
- *Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedure* (ADEC 2017)

This SOP focuses on the most commonly used monitoring well sampling tasks and should be used in conjunction with other applicable SOPs, including the following:

- BE-SOP-01: *Logbook Documentation and Field Notes*
- BE-SOP-02: *Sample Chain of Custody*
- BE-SOP-03: *Labeling, Packaging, and Shipping Samples*
- BE-SOP-04: *Quality Control Samples*
- BE-SOP-05: *Drilling and Core Logging*
- BE-SOP-14: *Equipment Decontamination*
- BE-SOP-20: *Water Quality Measurements*
- BE-SOP-22: *Monitoring Well Installation, Development, and Decommissioning*
- BE-SOP-66: *Breathing Zone Air Monitoring*

Groundwater sampling consists of collecting a water sample that is representative of the aquifer. Representative samples can be analyzed for groundwater contamination and/or naturally occurring analytes. Three common methods for well sampling include:

1. Low-Flow Method
2. Well-Volume Method
3. Low-Permeability Formation Method

Monitoring well sampling can be initiated as soon as the groundwater has re-equilibrated, is free of visible sediment, water quality parameters have stabilized, or 24 hours have passed following development (ADEC 2022).

Disturbance of the well, water column, and samples must be minimized, and only discrete grab samples may be collected. If multiple wells are to be sampled, the wells should be sampled from the least contaminated well progressing to higher levels of contamination. Groundwater samples need to be collected and analyzed for all appropriate contaminants of concern based on Appendix E of the *Field Sampling Guidance* and the project-specific work plan. Samples must be collected in the order of volatility (ADEC, 2022):

1. Volatile organic compounds (VOCs) and gasoline range organics (GRO)
2. Semi-volatile organic compounds (SVOCs); including diesel range organics/residual range organics (DRO/RRO), polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, and herbicides
3. Total organic carbon (TOC), and
4. Inorganic compounds (total metals, dissolved metals, nitrate/nitrite, and sulfide)

2.0 EQUIPMENT AND SUPPLIES

Groundwater sampling can be performed using several devices including submersible pumps, bladder pumps, peristaltic pumps, and bailers. Groundwater sampling devices must support the intended data use and site decisions, and selected groundwater purging and sampling equipment must minimize increases in sample temperature, water column agitation, and sample agitation (ADEC, 2022).

Groundwater sampling equipment may include, but is not limited to, the following:

- Appropriate level of personal protective equipment
- Well keys
- Camera
- Logbook, weatherproof pen, sharpie, etc.
- *Groundwater Sampling Form* (Attachment 1)
- Sample labels
- Sampling containers and packing materials
- Oil/water interface probe or water level indicator
- Submersible (e.g., Proactive Monsoon pump with low-flow controller, or equivalent), bladder (e.g., QED Sample Pro), or peristaltic pump (e.g., MasterFlex Easy-Flow)
- Disposable Teflon bailers and twine
- Graduated cylinder or beaker
- YSI water-quality meter or similar multimeter
- Hach turbidimeter
- Potable water and/or deionized water
- Tubing (Teflon, high-density polyethylene [HDPE] and/or silicone)
- Liquinox, Alconox, or equivalent
- RAE Systems MiniRAE photoionization detector (PID) (or similar), if necessary
- Colorimetric gas detector tubes, if necessary

3.0 PROCEDURES

3.1 RECORDING FIELD OBSERVATIONS

The *Groundwater Sampling Form* (Attachment 1) is intended to capture all of the information routinely collected during the sampling process for established monitoring wells. The field logbook is intended to record all equipment calibration checks, the wells sampled, sampling start and end times, or any other pertinent information not captured on the *Groundwater Sampling Form*.

3.2 FIELD EQUIPMENT DECONTAMINATION

Clean and/or decontaminate all equipment and materials used during groundwater sampling before use, as discussed in *Equipment Decontamination* (BE-SOP-14). Groundwater sampling equipment that typically requires decontamination includes all measurement devices before and between measurements at each well, groundwater sampling pumps between sampling at each well, water quality meters and probes and the inside of flow-through cells (ADEC, 2022). Used decontamination solution will be managed as investigation-derived waste, according to the project-specific work plan.

3.3 FIELD INSTRUMENT CALIBRATION

Field instruments will be calibrated in accordance with the manufacturer's recommended procedures and frequency for each instrument. Refer to *Water Quality Measurements* SOP (BE-SOP-20) and *Field Screening with PID* SOP (BE-SOP-15) for related procedures.

3.4 AIR MONITORING

Air monitoring will be conducted to screen for the presence of VOCs using a PID, or colorimetric gas detector tubes, if necessary. PID readings will be monitored until stable and then recorded in the field logbook. Procedures in the project-specific Site Safety and Health Plan (SSHP) and *Breathing Zone Air Monitoring* SOP (BE-SOP-66) will be followed if organic vapors are detected above concentrations listed in the air monitoring section of the SSHP.

Prior to removing the well plug, remove any standing water in the well annulus. Collect PID readings in situations as follows:

- To monitor the ambient conditions in the breathing zone when opening the well or removing the well plug.
- To monitor the headspace immediately after removing the well plug.
- To monitor the breathing zone after the well plug has been removed.

3.5 FREE PRODUCT AND WATER LEVEL MEASUREMENT

Measure the depth to groundwater (DTW), depth to product (DTP) if present, and total depth (TD) with an oil/water interface probe (or water level meter if no product) to the nearest 0.01-foot. Interface probes provide distinct responses when immersed in nonconductive product or conductive water. If non-aqueous phase liquid (NAPL) is encountered in a well, unless otherwise specified in the project-

specific work plan, do not collect laboratory samples (ADEC 2022). If samples are to be collected, remove the product with a bailer and make a note on the chain of custody that free product is present.

DTW, DTP, and TD are measured relative to an established reference mark from the top of the casing (TOC). The reference mark should be permanent, such as a small notch cut into the TOC or a permanent ink mark at the TOC. If a reference mark is not present, place a mark on the outside of the top north side of the well casing with indelible ink.

TD of a monitoring well should be compared to the well construction log to determine the thickness of silt present on the bottom, if present.

3.6 PURGING

Purging is the process by which stagnant water is removed from the well casing prior to sampling and replaced with groundwater from the adjacent formation. This allows for a representative sample to be collected from the actual aquifer condition.

Purging will be conducted in accordance with EPA and ADEC low-flow guidelines (EPA 2017, ADEC 2022). Monitoring wells will be purged, at a minimum, the equivalent of three times the well volume, or until a minimum of three (four, if using temperature) water quality parameters stabilize, or for low yield wells, the entire well casing is evacuated.

The formula to calculate one well casing volume is as follows:

*(TD of Casing – DTW) * Gallons per Foot of Casing*

Refer to Attachment 1 for the various gallons per foot of casing based on the diameter of the well.

All measurements, except turbidity, must be obtained using a flow-through cell. Water quality parameter stabilization is reached when three consecutive changes between successive readings at approximately 3 – 5 minute intervals are within:

- ± 3% for temperature,
- ± 0.1 for pH,
- ± 3% for conductivity,
- ± 10 millivolts for oxidation reduction potential,
- ± 10% for dissolved oxygen,
- ± 10% or ≤ 10 NTU for turbidity.

3.7 GROUNDWATER SAMPLING

3.7.1 Low-Flow Method

The low-flow sampling method uses groundwater quality parameters as indicators to determine when formation water is being discharged. Sampling at low-flow rates provides more accurate and reproducible samples of the formation water by minimizing hydraulic stress compared to high flow/high volume purging, while also reducing purge water volume. Low-flow sampling is not suitable for very low-yield wells, sampling in wells known to contain NAPL, and may require longer purge times (ASTM 2018).

Low-flow sampling is typically conducted using bladder pumps (positive displacement pumps), submersible pumps or peristaltic pumps. The use of Teflon-lined polyethylene tubing is preferred for the sample collection of organic compounds. For the analysis of per- or polyfluorinated alkyl substances hydrocarbons (PFAS) HDPE tubing is to be used; however, the use of HDPE equipment should be minimized to the extent practical (ADEC 2022).

Sampling of wells in order of increasing chemical concentrations (known or anticipated) is preferred. If wells contain free product, alternate wells that are representative of the affected groundwater should be sampled instead. Samples will be collected using the following steps:

- Measure and record the initial water level before installing the pump.
- Lower the pump or peristaltic pump tubing to the target depth below the static water level.
    - Record the depth of the pump on the Groundwater Field Data Form.
    - Consult the project-specific work plan for pump placement. Typically:
        - For wells screened across the groundwater interface, a pump intake of 1.0 to 2.0 feet below the static water level is typically used (ADEC, 2017).
        - For wells with submerged screens, set the pump intake at the middle of the screened interval (ASTM 2018).
- Begin purging water into a graduated bucket. Adjust the flow rate, as needed, so that drawdown does not exceed 0.33 feet (EPA 2002, ADEC 2022).
    - Flow rates typically range from 50 to 500 milliliters per minute (mL/min) (0.01 to 0.13 gallons per minute[gal/min]), but higher rates are consistent with low-flow guidelines as long as the drawdown requirement is met (ADEC 2022).
    - Flow adjustments are best made in the first 15 minutes of pumping in order to minimize purging time.
- After observable turbidity decreases, connect the flow-through cell to begin measuring and recording stabilization parameters and DTW on Attachment 1.
- Continue to purge and record measurements until stabilization criteria are met (Section 3.6) or a minimum of three or maximum of six well casing volumes are removed (EPA 2002).
- When collecting samples, disconnect the tubing from the flow-through cell and collect samples directly from the pump's tubing.
- Begin filling laboratory-supplied analytical sample containers in order of volatility as described in Section 1.0.
- Record sample information on the sample bottle labels and Attachment 1.

3.7.2 Well-Volume Method

This method is the default method used during low-flow sampling if groundwater stabilization parameters cannot be achieved. The well-volume method is based on purging three to six well volumes before sampling (EPA, 2002). One well casing volume of water may be calculated using the formula in Section 3.6.

Well-volume method sampling should be conducted as above in the Low-Flow Method, but:

- The purge rate should not be great enough to produce excessive turbulence in the well.

  - Flow rates typically range from 500 mL/min to 3.8 L/min (0.13 to 1 gal/min) in a 2-inch well (EPA 2002).
- Routinely measure and record groundwater parameters and DTW at approximately every 0.5 – 1 well volume interval on Attachment 1 (EPA 2002).
- Once groundwater parameters have stabilized and a minimum of three well casing volumes have been removed, record the final measurements.
- If parameters have not stabilized within six well volumes, stop purging and record the final measurements.
- Reduce the flow rate of the pump to about 0.13 gal/min and collect samples as above (EPA 2002).

3.7.3 Low-Permeability Formation Method

If a well is screened in low hydraulic conductivity aquifers (silt and clay) there may be no way to avoid pumping or bailing a well dry. Low-flow purging and sampling are useful for wells that purge dry or take one hour or longer to recover (ADEC 2022).

If a low yield well is purged dry, and it is not possible to obtain groundwater stability parameters:

- Purge the well dry and allow the well to recover until at least one of the following is met:
  - If full recovery exceeds one hour, collect samples as soon as the well has recharged to 80 percent of the DTW (ADEC 2022).
  - A minimum of 2 hours has passed since purging (EPA 2002).
  - There is sufficient water volume present to obtain a sample.
- Collect samples in order of volatility, as described in Section 1.0.
  - Bailers or a peristaltic pump may be used; however, analytical results may be biased low for VOCs if using a peristaltic pump or biased high for metals if using a bailer due to increased turbidity (EPA 2002).

4.0 POTENTIAL INTERFERENCES

Two potential interferences associated with groundwater sampling are cross-contamination and a lack of sample representation due to improper well purging or stabilization. Cross-contamination can be a significant problem when attempting to characterize low concentrations of organic compounds or when soils are highly contaminated (ADEC 2017). To prevent cross-contamination between wells, dedicated tubing can be placed in each well and all non-disposable equipment that may directly or indirectly come in contact with samples will be decontaminated prior to use at a different location. The *Equipment Decontamination* SOP (BE-SOP-14) outlines the decontamination procedure. To ensure that representative conditions within the aquifer are captured during sample collection, the purge rate will be maintained at a rate that produces minimal drawdown until three well casings have been removed or until water quality parameters have stabilized, as described in Section 3.6.

5.0 SAMPLE HANDLING, PRESERVATION, AND STORAGE

The following procedure will be followed for sampling handling, preservation, and storage:

1. Transfer the sample into a labeled container.
2. Preserve the sample or use pre-preserved sample bottles (if required by analytical method).
3. Cap the container and place into a cooler to maintain 4 ± 2°C (if required by analytical method).
4. Record all pertinent data in the site logbook and/or on the field data sheet.
5. Complete the chain of custody form.
6. Attach the custody seals to the cooler prior to shipment.

Refer to the *Labeling, Packaging, and Shipping* SOP (BE-SOP-03) for procedures on labeling, packaging, and shipping samples.

6.0 DATA AND RECORD MANAGEMENT

The chain of custody form is signed over to the laboratory. A copy is kept with the sampling records. Refer to *Sample Chain of Custody* SOP (BE-SOP-02) for procedures on sample chain-of-custody.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

All field Quality Control (QC) sample requirements in the project-specific work plan must be followed. These may involve trip blanks, equipment blanks, field duplicates, and the collection of additional sample volumes for the laboratory's quality control (matrix spike and matrix spike duplicates). The frequency of QC samples will be outlined in the project-specific work plan. Refer to the *Quality Control* SOP (BE-SOP-04) for procedures on quality control samples.

8.0 REFERENCES

ADEC. 2017 (March). *Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedure.*

ASTM. 2018 (September). D6671 - *Standard Practice for Low-Flow-Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations*

ADEC. 2022 (January). Field Sampling Guidance.

U.S. EPA. 2002 (May). *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*. Office of Solid Waste and Emergency Response. EPA 542-S-02-001.

U.S. EPA. 2017 (September). *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*. EPA 540-S-95-504.

ATTACHMENTS

Attachment 1 Groundwater Sampling Data Form

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GROUNDWATER SAMPLING DATA FORM

Well ID:_____

Project Name: _____ Date: _____

Project Number: _____ Start Time: _____

Sampling Team: _____ End Time: _____

Sample ID: _____ Time: _____ primary dup other: _____

Sample ID: _____ Time: _____ primary dup other: _____

Sample ID: _____ Time: _____ primary dup other: _____

Depth to Top of Product (BTOC): _____ Total Depth (BTOC): _____

Depth to Oil/Water Interface (BTOC): _____ Depth to Water (BTOC) _____

Casing Diameter:	*1 in.*	*2 in.*	*4 in.*
gal/ft of casing:	*0.041*	*0.163*	*0.653*

Water Column (ft) _____

Casing Volume (gal) _____

Pump Intake Depth: _____ Screen Interval _____

Stable DTW (BTOC): _____ Measured Stick-up _____

Method of Purging (circle one):

Pump: SUB BLDR PERIST OTHER:

Pump Type: Flow Rate (gpm):

Pump Time:

Bailer: TEFLON SS OTHER:

Required Pulls: Bailer Vol. (gal): 0.25 / 0.33

Vol. Purged (gal):

WELL STABILIZATION DATA

Time	Total Volume Purged (gallons)	Water Level (ft BTOC)	Draw Down	Temp. (°F or °C)	pH	Conductivity (µS/cm)	ORP (mV)	D.O. (mg/L)	Turbidity (NTU)
				± 3%	± 0.1	± 3%	± 10mV	± 10%	± 10% or <10 NTU

Notes: Drawdown should be less than 0.3 feet from the original DTW. Minimal drawdown achieved and measured by: 1) pumping at a low rate (approx. 1 liter/3 minutes or 0.26 gallons/3 minutes or 50-500 mL/min) **and** 2) continually measuring water levels in the well.
Sample after 1) removing min. of 3 casing volumes **or** 2) min. of 3 parameters stabilize (4, if using temp.), **or** 3) for low yield wells, entire well casing is evacuated (ADEC, 2013).

Sensory Observations

Color: Clear, Amber, Tan, Brown, Gray, Milky White, Other

Odor: None, Low, Medium, High, Very Strong, H2S, Fuel-Like, Chemical ?, Unknown

Turbidity: None, Low, Medium, High, Very Turbid, Heavy Silts

Comments:

WELL STABILIZATION DATA

Time	Total Volume Purged (gallons)	Water Level (ft BTOC)	Draw Down	Temp. (°F or °C)	pH	Conductivity (µS/cm)	ORP (mV)	D.O. (mg/L)	Turbidity (NTU)
				± 3%	± 0.1	± 3%	± 10mV	± 10%	± 10% or <10 NTU

STANDARD OPERATING PROCEDURE

BE-SOP-14

Equipment Decontamination

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for decontamination of reusable equipment.

2.0 MATERIALS

Materials used for decontamination may include:

- Level D Personal Protective Equipment (PPE) – nitrile or rubber gloves, safety glasses, safety toed boots, hard hat and safety vest (if decontaminating drilling or heavy equipment)
- Hand tools for bulk contamination removal (shovels, brooms, etc.)
- Liquinox or Alconox
- Spray or rinse bottles, or pump sprayer
- Pressure washer/steam cleaner
- Potable water
- Distilled or deionized water
- Bristle brushes
- Plastic tubs
- Plastic sheeting
- Department of Transportation (DOT)-approved, 5-gallon buckets with screw top lids
- DOT-approved, 55-gallon open-top drums
- Contractor-grade plastic bags
- Paper towels

3.0 PROCEDURE

Reusable sampling equipment must be decontaminated between samples and at the end of each workday. Drilling and excavation equipment should be decontaminated prior to beginning site activities, before collecting each sample when non-dedicated sampling equipment is used, and after completing site activities. Decontamination procedures are detailed in the following subsections.

3.1 DECONTAMINATION AREA

Identify a localized decontamination area for larger drilling and excavation equipment. Select an area with easy access and level ground to minimize slip, trip, and fall hazards. The decontamination area should be large enough to temporarily store clean equipment and materials and stage drums of investigation-derived waste (IDW). When decontaminating larger drilling tooling, such as hollow-stem augers, line each

area with a heavy-gauge plastic sheeting and include a collection system designed to capture potential decontamination wastes (water and residual soil). Containerize decontamination water and residual soil in approved containers, such as DOT-approved 55-gallon drums. Decontamination areas should be set up to minimize overspray and risk to the surrounding environment.

Smaller equipment (spoons, trowels, groundwater sampling pumps, etc.) may be decontaminated near the sampling locations. In this case, all required decontamination supplies must be mobilized to the sampling location. A 5-gallon bucket with a screw top lid or a plastic tub should be used to capture decontamination water, which should be transferred to larger containers, as necessary.

3.2 SAMPLING EQUIPMENT DECONTAMINATION

Improper decontamination can cause cross-contamination. To prevent cross-contamination, sampling equipment must be either disposed of after one use or decontaminated after each use. Disposable or dedicated sampling equipment should be used whenever possible. When non-dedicated, reusable equipment is used, it should be decontaminated in stages in a way that minimizes contaminant discharge to the environment. The following procedures should be used:

1) Remove as much bulk contamination as possible from equipment at the point of origin.
2) Wash equipment thoroughly with potable water containing a laboratory-grade detergent, such as Liquinox or Alconox. Use a bristle brush to remove any remaining residual contamination.
3) Rinse equipment thoroughly with potable water.
4) Rinse equipment thoroughly with distilled or deionized water. Note that some instruments can be damaged by deionized water, such as YSI 556 probes.
5) Air dry equipment in clean area free of dust or other fugitive contaminants. Alternatively, wet equipment may be dried with a clean, disposable paper towel to assist the drying process. All equipment should be dry before reuse.
6) Store clean and dry sampling equipment within a protective medium (plastic bag, carrying case, etc.).

3.3 HEAVY EQUIPMENT DECONTAMINATION

Equipment decontamination must be performed prior to transporting or walking equipment between contaminated areas. Decontamination will focus on minimizing the spread of contaminated media resulting from equipment movement or transport. This decontamination process will use dry methods (brooms, brushes, shovels, etc.) within the exclusion zone to remove large, easily dislodged deposits of soil and other contaminated media from equipment (tracks, buckets, etc.) prior to exiting the exclusion zone. The Field Lead may alter decontamination procedures based on dry decontamination effectiveness.

Final decontamination should be conducted when equipment is no longer needed onsite. A decontamination area should be established to collect decontamination materials, sludge, and water. Bulk contamination should be removed using shovels and brushes, and the equipment should be further cleaned using a pressure washer with a detergent wash, followed by a potable water rinse, if needed.

3.4 PERSONNEL AND PERSONAL PROTECTIVE EQUIPMENT (PPE) DECONTAMINATION

During environmental investigations and removal actions, boots and gloves are commonly the most contaminated types of PPE. Contaminated solids such as mud should be scraped and wiped from boots. Personnel decontamination involves removal of bulk contamination first. Any remaining contamination should be removed using soapy water and brushes. Once all debris is removed, rinse the boots with clean water. If boots are not laden with solid materials, a brush can be used to knock off or remove any residual solid materials. If the boots have contacted liquid-phase contaminants, it is important that the contaminants be removed using soapy water and a brush, followed by a clean water rinse. If the contaminants have adsorbed into the boots, the boots must be replaced. Gloves should be removed rolling the glove off from the top down to avoid contact with contaminated soil.

Following removal and cleaning of reusable PPE, field personnel should wash their hands or any exposed body parts which may have been in contact with the associated contaminated substances.

4.0 INVESTIGATION DERIVED WASTE MANAGEMENT

Typical investigation derived wastes consist of soil cuttings, decontamination water, and solid wastes.

1) Soil cuttings should be containerized in open-top, DOT-approved, 55-gallon drums. Decontamination water should be collected in plastic troughs or tubs, DOT-approved 55-gallon drums, or DOT-approved 5-gallon buckets with screw top lids.
2) Solid wastes generated during decontamination activities should be containerized in contractor grade plastic bags.
3) All wastes must be treated or disposed of in accordance with applicable state and federal regulations, as specified in the Waste Management Plan.
4) Prior to transporting soil cuttings or decontamination water off-site, an ADEC Contaminated Media Transport and Treatment or Disposal Approval Form must be submitted to the ADEC Project Manager for approval.

5.0 QUALITY CONTROL

Quality Control (QC) samples may be collected to verify that the decontamination process is effective. QC samples include equipment rinsate blanks and equipment wipe samples, which are described in the *Quality Control Samples* SOP (BE-SOP-04).

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STANDARD OPERATING PROCEDURE

BE-SOP-15

PID Field Screening

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to describe photoionization detector (PID) field screening procedures. The procedure is applicable to the MiniRae 2000 PID model.

2.0 EQUIPMENT

The following equipment is needed for field screening:

- Appropriate PPE nitrile gloves, safety glasses, hard hat, safety vest, safety-toed boots, hearing protection
- PID calibration form
- Logbook
- Camera
- Permanent ink pen
- Quart-size zip-top bags
- Moisture filters
- Lamp cleaning kit
- Clean sampling spoons or trowels
- PID
- Isobutylene calibration gas 100 parts per million (ppm) and regulator
- Tedlar bag

3.0 PID OVERVIEW

The MiniRae 2000 Portable Volatile Organic Compound (VOC) Monitor (Model PGM 7600) is a nonspecific, vapor/gas detector that is used to detect a variety of organic compounds in air. It utilizes an electrodeless discharge UV lamp as the high-energy photon source. When organic vapors pass by the lamp, they are photo-ionized and the ejected electrons are detected as a current. Three UV lamps with different photon energies are available: 9.8 eV, 10.6 eV, or 11.7 eV. The 11.7eV lamp measures the widest range of analytes while the 9.8 eV lamp is selective to easily ionizable compounds like aromatics. The 10.6 eV lamp is the most commonly used lamp and will measure compounds with ionization energy lower than that of the lamp.

The instrument is designed to continuously monitor VOC vapors between 0 and 10,000 ppm. An audio alarm and a flashing LED display are activated when these limits are exceeded. Default preset alarm thresholds are programed in the PID before leaving the factory. Alarm limits for the STEL, TWA, and low-

and high-level peak values can be reset following the instructions in the Operational and Maintenance Manual.

4.0 INSTRUMENT CALIBRATION

The PID should be calibrated daily prior to beginning work and as needed during operation. The calibration process includes a fresh air calibration to determine the zero point of the sensor calibration curve followed by a span calibration using a standard reference gas to determine a second point of the sensor calibration curve. These calibration procedures are detailed in the following subsections.

4.1 Fresh Air Calibration

The fresh air calibration is performed in clean ambient air away from any possible contaminants using the following procedures:

1) Use a clean moisture filter or carbon filter.
2) Turn on PID and allow it to cycle through the warmup process. The unit is ready when it displays a reading.
3) Press and hold [Mode] and [N/-] buttons together until the “Calibration/Select Gas?” menu appears. Press the [Y/+] button.
4) The “Fresh air Cal?” menu will appear. Once ready to begin the calibration, press the [Y/+] button. The display will show “zero in progress” followed by “wait...” and a countdown timer.
5) After approximately 15 seconds, the display will show the message “zeroed... reading = X.X ppm.” Press any key or wait approximately 20 seconds and the monitor will return to the “Fresh air Calibration?” menu.
6) Record the fresh air calibration reading on the PID Calibration Form.

4.2 Span Calibration

The span calibration is performed using a standard reference gas (100 ppm Isobutylene) fitted with a 500 cc/minute flow-limiting regulator or a flow-matching regulator (required to match the pump flow rate). Alternatively, a Tedlar bag can be filled with calibration gas. Use the following procedures to complete the span calibration:

1) Open valve on regulator or Tedlar bag and connect the PID.
2) Press the [Y/+] on the “Span Cal?” menu to start the calibration. The display will show the gas name and the span value of the corresponding gas.
3) The calibration can be started manually by pressing any key while the “Apply gas now!” is displayed.
4) The display will show “wait.... 30" with a countdown timer showing the number of remaining seconds while the monitor performs the calibration.
5) During calibration, the monitor waits for an increased signal before starting the countdown timer. If a minimal response is not obtained after 35 seconds, the monitor displays “No Gas!” Check that the span gas valve is open and for lamp or sensor failure before trying again.
6) When the countdown timer reaches 0, the display shows the calibrated value, which should be within 5% of the span gas value.

7) After a span calibration is completed, the display will show the message "Span Cal Done! Turn Off Gas"
8) It is recommended that you bump check the PID at this point to confirm that the calibration was successful.
9) Turn off the flow of gas. Disconnect the calibration adapter from the MiniRAE 2000 monitor.
10) Press any key to return to the "Span Gas Cal?" menu.
11) Record the span calibration reading on the PID Calibration Form.

4.3 Equipment Testing

The PID should be bump checked with 100 ppm isobutylene gas at frequent intervals using the following procedures:

1) Turn on PID and allow it to warm up.
2) While the pump is on and collecting air, use a regulator or Tedlar bag to deliver the calibration gas to the instrument probe.
3) Record the reading in the field logbook.
4) Assess whether the reading is within the acceptance criteria (typically 5%).

If the bump check indicates that the instrument is not reading within the acceptance criteria, recalibrate the PID and re-check. If the reading remains outside the acceptance criteria, perform maintenance or replace the unit.

5.0 SCREENING

PIDs can be used to monitor ambient air for contaminant exposure, or to screen soils for organic vapors.

5.1 Contaminant Exposure Air Monitoring

For contaminant exposure monitoring, use the hygiene mode to ensure that the unit runs continuously and hold the PID in the area of interest. Areas of interest may include the breathing zone for employee exposure, within a contaminant source area, or around the perimeter of contamination. Monitor the concentrations displaying on the PID screen. If concentrations exceed 20 ppm in the breathing zone, work should be stopped and site conditions should be re-evaluated. Additional PPE may need to be donned to ensure that the Occupational Safety and Health Administration and National Institution for Occupational Safety and Health exposure limits are not exceeded.

5.2 Heated Headspace Screening

To screen soils for organic vapors using the heated headspace method, follow these procedures:

1) Collect soil from the sample retrieval device using a clean sampling spoon.
2) Place the soil in a clean, quart-size, re-sealable plastic bag until the bag is one-third to one-half full and seal the bag completely. It is important to use a quart-sized bag as larger bags effect vapor diffusion and stratification. Consistent soil volumes must be placed in the bag to ensure comparable screening results (when adequate soil volumes area available).

3) Warm the bagged sample to at least 40 Fahrenheit to enhance volatilization. Warming should occur for at least 10 minutes, but it should not exceed 1 hour. Agitate the sample for 15 seconds at the beginning and end of warming to assist volatilization.
4) Once the sample is adequately warmed, insert the PID probe into the bag by puncturing the bag at a point approximately one-half of the headspace depth. Take care to prevent uptake of soil particles or moisture droplets. Use a moisture filter on the PID probe to prevent damage to the instrument.
5) Record the highest concentration reading on the soil boring log. The maximum reading typically occurs between 2 and 5 seconds after inserting the probe. Note erratic readings in the field logbook.

6.0 MAINTENANCE

Routine maintenance must be performed by qualified personnel. Maintenance should include inspection of the following components:

- Battery Pack
- Sensor module
- PID lamp
- Sampling pump
- Inlet connectors and filters

Any components that are not functioning as intended should be repaired or replaced.

6.1 Battery Charging and replacement

When the PID display shows a flashing message “Bat”, the battery requires recharging. The PID should be recharged daily after returning from field. A fully charged battery will last for approximately 10 hours of continuous monitoring. The built-in charging circuit is controlled by the micro-controller to prevent over-charging. The battery may be replaced in the field, if required. Refer to the Operational and Maintenance Manual for instructions on “Replacing the Battery Pack and Replacing the Alkaline Battery Adapter.”

6.2 Troubleshooting

Common troubleshooting procedures are listed in the following table.

Problem	Reasons and Solutions
Cannot turn on power after charging the battery	**Reasons:** Discharged battery; defective battery; microcomputer hang-up. **Solutions:** Charge or replace battery; disconnect, then connect the battery to reset computer.
Reading abnormally high	**Reasons:** Dirty sensor module; dirty water trap filter; excessive moisture and water condensation. **Solutions:** Clean sensor module and lamp housing; replace water trap filter; blow dry the sensor module.
Reading abnormally low	**Reasons:** Incorrect calibration; low sensitivity to the specific gas; weak or dirty lamp; air leakage. **Solutions:** Calibrate the monitor; replace sensor; clean or replace lamp; check air leakage.
"Lamp" message during operation	**Reasons:** Lamp drive circuit; lamp threshold set too high; weak or defective PID lamp. **Solutions:** Check and reset lamp threshold; replace the UV lamp.
Calibration error message	**Reasons:** No standard gas input; weak PID lamp; unit zeroed with gas present. **Solutions:** Make sure standard gas flows into the monitor; zero sensor & recalibrate; replace lamp.
Random readings	**Reasons:** Incorrect calibration gas value; low sensitivity to calibration gas; weak or dirty lamp. **Solutions:** Calibrate the sensor; use different calibration gas; clean or replace lamp; check air leakage.

7.0 REFERENCES

RAE Systems. 2005. MiniRAE 2000 Portable VOC Monitor PGM-7600, *Operational and Maintenance Manual*. Document No. 011-4001-000. May.

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STANDARD OPERATING PROCEDURE

BE-SOP-20

Water Quality Measurements

1.0 INTRODUCTION

The purpose of the Standard Operating Procedure (SOP) is to describe the methods of calibrating, maintaining and operating water quality meters and probes used for groundwater sampling. The YSI 556 Multi-Probe System (MPS) and Aqua TROLL 500 are common multimeters used which will simultaneously measure temperature, conductivity, pH, dissolved oxygen (DO), and oxidation reduction potential (ORP). This SOP also describes the guidelines for calibration and operation of the Hach Portable Turbidity Meter. The manufacturer's operator's manual should be referred to for specific calibration, operation procedures and troubleshooting.

This SOP was developed in accordance with the following guidance documents:

- *Field Sampling Guidance* (Alaska Department of Environmental Conservation [ADEC], 2022)
- *Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations* (American Society for Testing and Materials [ASTM], 2018)

This SOP focuses on the mostly commonly used collection methods of field water quality parameters and should be used in conjunction with other applicable SOPs, including the following:

- BE-SOP-01: *Logbook Documentation and Field Notes*
- BE-SOP-09: *Groundwater Sampling*
- BE-SOP-10: *Surface Water Sampling*
- BE-SOP-14: *Equipment Decontamination*
- BE-SOP-21: *Groundwater and LNAPL Measurements*

2.0 EQUIPMENT AND SUPPLIES

Calibration and water quality measurement equipment will include, but is not limited to the following:

- Multimeter, which may include:
    - YSI 556 MPS (or similar)
    - YSI 5563 Probe Module
    - Aqua TROLL 600 Multiparameter Sonde, Wireless TROLL Com communication device, and Aqua TROLL tablet with VuSitu App
- Flow-through cell
- Discharge hoses and fittings to attach sample tubing to the flow-through cell
- Calibration standards (pH 4, 7, and 10, ORP, and conductance)
- Aqua TROLL Quick-Cal Multiple Sensor Solution, if using Aqua TROLL
- Rugged DO (RDO) calibration sponge or 100% saturation bubbler, if using Aqua TROLL

- Deionized water (DI)
- Spray bottle
- Graduated cylinder or beaker, if needed
- 5-gallon buckets
- Portable turbidity meter (e.g., Hach 2100P or Hach 2100Q) and turbidity standards (<0.1, 20, 100, and 800 NTU)
- Appropriate level of personal protective equipment
- Logbook, weatherproof pen, sharpie, etc.
- Multi-parameter and turbidimeter calibration logs (Attachment 1 and 2)

3.0 PROCEDURES

Calibrate or perform a calibration check on equipment daily. Calibration readings should be documented in the field logbook and/or calibration logs (Attachment 1 and 2). If a field instrument will not calibrate, perform troubleshooting as described in the manufacturer's manual. If the issue cannot be resolved, use a backup instrument. If that is not an option, contact the Project Manager on whether data collection will continue or if any other corrective actions should be taken. Flag any data recorded from a meter with suspected calibration problems on the field forms. If anomalous field readings are given during sample collection, stop and recalibrate the instrument.

3.1 CALIBRATION OF YSI 556 MPS

The transport/calibration cup that comes with the probe module serves as the calibration chamber and minimizes the volume of calibration reagents required. The key to successful calibration is to ensure that the sensors are completely submersed when calibration values are entered. For maximum accuracy, use a small amount of calibration solution to pre-rinse the probe module (YSI, 2009). Consult the YSI operation's manual for further information.

3.1.1 pH

Always calibrate pH using the 3-point calibration method. The 3-point calibration method accounts for the full pH range and assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. To calibrate pH:

- Select the 3-point option to calibrate the pH sensor using three calibration solutions.
- When calibrating pH, always calibrate with buffer 7 first.
- Place 30 milliliters (mL) of pH buffer into a clean, dry, or pre-rinsed transport/calibration cup, and securely tighten the cup on the threaded end of the probe module.
- Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.
- Enter the calibration value of the buffer at the current temperature.
- Press **Enter**. The pH Calibration screen is displayed.
- Allow at least one 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.

- When the readings show 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.
- After returning to the Calibrate screen, rinse the probe module and sensors with tap or purified water and dry.
- Repeat these steps using a second pH buffer, and then repeat again using a third pH buffer.
- After returning to the Calibrate screen, rinse the probe module and sensors with tap or purified water and dry.

3.1.2 Conductivity

For maximum accuracy, the conductivity standard should be within the same conductivity range as the samples you are preparing to measure.

- For fresh water use a 1 mS/cm conductivity standard.
- For brackish water use a 10 mS/cm conductivity standard.
- For seawater use a 50 mS/cm conductivity standard.

Always calibrate conductivity for specific conductance. Calibrating for specific conductance will automatically calibrate for conductivity and salinity. To calibrate specific conductance:

- Place 55 mL of conductivity standard into a clean, dry, or pre-rinsed transport/calibration cup, and securely tighten the cup on the threaded end of the probe module.
- Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.
- Enter the calibration value of the standard you are using in mS/cm at 25°C and press **Enter**.
- Allow at least one 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.
- When the readings show 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.
- After returning to the Calibrate screen, rinse the probe module and sensors with tap or purified water and dry.

3.1.3 ORP

To calibrate for ORP:

- Place 30 mL of a known ORP solution into a clean, dry, or pre-rinsed transport/calibration cup, and securely tighten the cup on the threaded end of the probe module.
- Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.
- Enter the correct value of the calibration solution at the current temperature. Refer to the solution values on the calibration standard bottle.
- Press **Enter**. The ORP calibration screen will be displayed.

- Allow at least one minute for temperature equilibration before proceeding. Verify that the temperature reading matches the value you used.
- Observe the reading under ORP. 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.
- After returning to the Calibrate screen, rinse the probe module and sensors with tap or purified water and dry.

3.1.4 DO

Always calibrate for % DO. Calibrating for % DO will automatically calibrate for mg/L. The instrument must be on for at least 10 – 15 minutes to polarize the DO sensor before calibrating. To calibrate dissolved oxygen:

- Place 1/8 inch (3 mm) of water in the bottom of the transport/calibration cup.
- Place the probe module into the transport/calibration cup.
    - Make sure the DO and temperature sensors are **not** immersed in the water.
- Engage only 1 or 2 threads of the transport/calibration cup to ensure the DO sensor is vented to the atmosphere.
- Use the keypad to enter the current local barometric pressure in mmHg.
    - If the unit has the optional barometer, no manual entry is required.
- Press **Enter**. The DO % saturation calibration screen will be displayed.
- Allow approximately 10 minutes for the air in the transport/calibration cup to become water saturated and for the temperature to equilibrate before proceeding.
- Observe the reading under DO %. 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.
- After returning to the Calibrate screen, rinse the probe module and sensors with tap or purified water and dry.

3.2 AQUA TROLL 500 MULTIPARAMETER SONDE

The restrictor attached in storage/calibration mode serves as the calibration chamber and minimizes the volume of calibration reagents required. For best calibration, it is recommended to rinse twice with the calibration solution to ensure all contaminants have been removed (In Situ, 2019). Aqua TROLL may be calibrated using single sensor calibration standards for pH, conductivity, and ORP. However, the Aqua TROLL sonde may also be calibrated using a multi-sensor calibration standard, Quick-Cal Solution, for these three parameters.

3.2.1 Solution-Based Calibration

Refer to the Aqua TROLL operator's manual if using single sensor calibration standards. The following procedures will be used for performing a multi-sensor calibration using Quick-Cal Solution:

- Ready the instrument for calibration
    - Remove the rubber bumper and blue top cap from the restrictor.

- Remove the restrictor and reattach in calibration mode to form the calibration cell.
- Invert the instrument, so the sensors are facing up.
- Rinse the sensors with DI or tap water. Ensure the sensor face and inside of calibration cell are clean and free of debris.

- Ready the tablet for calibration
  - From the main menu, select **Connected Instrument.**
  - Select **Calibrations**.
  - Select **Quick-Cal (multi-sensor)**.
    - All available sensors are selected by default. If one or more sensors are not installed properly, an error message will pop up.
  - Select **Next**.
- Solution Rinse Procedure
  - Pour 10 – 20 mL (½-inch above the sensor face) of the calibration standard onto the sensors to perform the first rinse.
  - Ensure the solution comes in contact with the sensors by moving the solution around in the calibration cell. Reinstall the blue top cap and shake gently, if necessary.
  - Discard the calibration standard.
  - Repeat solution rinse procedure. Aqua TROLL recommends two rinses to ensure the best calibration of the instrument.
- Sensor Calibration Procedure
  - Fill the calibration cell with 40 – 50 mL (to the bottom of the threads inside the restrictor) with fresh calibration solution.
    - Check the sensor for bubbles and gently tap to remove any bubbles.
  - Select **Next**.
  - After the calibration is stable, select **Accept**.
  - The calibration values applied to the sensor will appear on-screen. Select **Done** to return to the calibration menu.

3.2.2 DO 100% Saturation Calibration

The RDO sensor is typically calibrated using a 1-point calibration method. The water saturated air method is most commonly used, while the saturation bubbler method requires an additional calibration chamber. Other calibration methods are available in the owner's manual. The factory calibration of the RDO sensor should produce readings within 3% accuracy (In Situ, 2019). If greater accuracy is required, In-Situ recommends performing a 1-point 100% water-saturated air calibration using the following procedure:

- From the main menu, select **Connected Instrument**.
- Select **Calibrations**.
- Select **RDO Saturation**.
- For a 1-point calibration, select **100% Saturation**.
- Set up the instrument for one of the following methods:

<u>Option 1 – Water Saturated Air</u>

- Remove the restrictor and thoroughly dry the RDO sensing foil and temperature sensor.
- Saturate a small sponge with water (does not need to be dripping).

- Place the sponge in the bottom of the restrictor and attach the end cap, turning one full rotation.
    - Do not fully seal the bottom of the restrictor.
- Wait 5 – 10 minutes for 100% water saturation of the air within the calibration chamber before starting the calibration.
- After the calibration chamber has stabilized, select **Next**.
- After calibration is stable, select **Next**.
- The calibration values will be applied to the sensor and appear on-screen. Select **Done** to return to the Calibration Menu.

Option 2 – Bubbler

- Fill at 100% saturation bubbler half full of tap water.
- Turn on the bubbler.
- Wait 5 – 10 minutes for the bubbler to reach 100% saturation.
- Install the restrictor in deployment mode, remove blue end cap and place the sonde in the bubbler.
- After the calibration chamber or bubbler have stabilized, select **Next**.
- After calibration is stable, select **Next**.
- The calibration values will be applied to the sensor and appear on-screen. Select **Done** to return to the Calibration Menu.

3.3 HACH PORTABLE TURBIDIMETER

The Hach Model 2100P or 2100Q Portable Turbidimeter measures turbidity from 0.01 to 1000 NTU in automatic range mode with automatic decimal point placement. For more information, consult the Hach user manual. Use the following procedure for turbidity measurements:

- Collect a representative sample in a clean container. Fill a sample cell to the line (about 15 mL), taking care to handle the sample cell by the top. Cap the cell.
- Wipe the cell with a soft cloth to remove water spots and fingerprints.
- Apply a thin film of silicone oil. Wipe with a soft cloth to obtain an even film over the entire surface.
- Turn the instrument on and place on a flat sturdy surface.
- Insert the sample cell in the instrument call compartment so the diamond or orientation mark aligns with the raised orientation mark in from of the cell compartment.
- Press **READ** and the result will show in units of NTU.

3.3.1 Calibration of Hach 2100Q Portable Turbidimeter

For best consistency and accuracy, calibrate using the StablCal Calibration Set and always insert the cell so the orientation mark on the cell is correctly aligned with the mark on the front of the cell compartment (Hach, 2017).

- Push the **Calibration** key to enter the Calibration mode.
    - Gently invert each standard before insertion.
- Insert the 20 NTU StablCal Standard and close the lid.

- Push **Read**. The display shows Stabilizing and then shows the result.
- Repeat with the 100 NTU and 800 NTU StablCal Standard.
- Push **Done** to review the calibration details.
- Push **Store** to save the results.

3.4 COLLECTION OF WATER QUALITY MEASUREMENTS

Water quality parameters (DO, ORP, pH, and conductivity) are chemical properties measured to determine when discharged groundwater is considered representative of the formation water and sampling can begin (ASTM, 2018). Water quality parameters are measured using a multi-parameter instrument coupled with an in-line flow- through cell. The typical volume of the flow-through cell is 500 mL.

3.4.1 Groundwater Parameters

Follow this general procedure for collecting water quality parameters using a flow-through cell:

- Secure the instrument to the flow-through cell. Connect a short discharge tube to the effluent connector at the top of the flow-through cell and run the other end of this discharge tube into a 5-gallon purge water bucket.
- Place the tube from the pump directly into the 5-gallon purge water bucket and purge for approximately half a minute or until the purge water begins to visually clear up. The intent is to limit any initially highly turbid water from accumulating in the flow-through cell.
- Once visually clear, secure the tube from the pump to the influent connector at the bottom of the flow-through cell.
- Continue low flow purging at a flow rate of approximately 1 liter (0.26 gallons) every 3-5 minutes, or 50 – 500 mL/min (ADEC, 2022).
- Routinely measure and record required parameters and the depth to groundwater every 3-5 minutes. A minimum of three recordings will be monitored and recorded.
- Continue to monitor until parameters stabilize or until three well casing volumes have been purged. Use the following stabilization parameters (ADEC, 2022):
    - ± 3% for temperature (minimum of ± 0.2 °C),
    - ± 0.1 for pH,
    - ± 3% for conductivity,
    - ± 10 mv for redox potential,
    - ± 10% for DO, and
    - ± 10% for turbidity.
- When parameters have stabilized, record final measurements, and collect samples per the project-specific work plan.

Note: Low-flow purging and sample collection are particularly useful for wells that purge dry or take one hour or longer to recover. If a well is purged dry or recovery exceeds one hour, collect a sample as soon as the well has recharged to approximately 80% of its pre-purge volume, when practical (ADEC, 2022).

3.4.2 Surface Water Parameters

Water quality measurements should be taken when collecting surface water samples. Additional parameters (stream discharge rate, salinity, etc.) may be necessary when collecting surface water samples (ADEC, 2022). Section 8.0 of the ADEC *Field Sampling Guidance* (2022) contains additional information for surface water sampling and parameter collection.

4.0 DATA AND RECORD MANAGEMENT

The *Multi-Parameter Calibration Log* (Attachment 1) and the *Turbidimeter Bump Check Log* (Attachment 2) are intended for use in the field during groundwater sampling and monitoring well development activities. Complete these datasheets according to this SOP and the *Logbook Documentation and Field Notes* (BE-SOP-01).

5.0 REFERENCES

ADEC. 2022. *Field Sampling Guidance*. January.

ASTM. 2018. *Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations.* D6771. West Conshohocken, Pennsylvania. September.

Hach Company. 2017. *Hach 2100Q and 2100Qis User Manual. December.*

In-Situ. 2020. *Aqua TROLL 500 Multiparameter Sonde Operator's Manual. November*

YSI Environmental. 2009 (August). *YSI 556 Multi Probe System Operations Manual.*

Attachments

Attachment 1 Multi-Parameter Calibration Log
Attachment 2 Turbidimeter Bump Check Log

Attachment 1

Multi-Parameter Calibration Log

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Multi-Parameter Calibration Log

Project Name/Location:____

Project Number:____

Equipment Make and Model(s):________________________ & ________________________

Serial Number(s): ________________________ & ________________________

Serial Num.	Date	Temp.	pH (3 pt.)		Cond. (us/cm)		ORP (mV)		DO (100%)		Initials
			Standard	Reading	Standard	Reading	Standard	Reading	Atm. Press. (mmHg)	Reading (%)	

Serial Num.	Date	Temp.	pH (3 pt.)		Cond. (us/cm)		ORP (mV)		DO (100%)		Initials
			Standard	Reading	Standard	Reading	Standard	Reading	Atm. Press. (mmHg)	Reading (%)	

Attachment 2

Turbidimeter Bump Check Log

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Turbidity Meter Calibration Verification Check

Project Name/Location: ____

Project Number: ____

Equipment Make and Model(s): ______________________________ & ______________________________

Date	Time	Serial #:			Serial #:			Initials
		_____NTU	_____NTU	_____NTU	_____NTU	_____NTU	_____NTU	

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STANDARD OPERATING PROCEDURE

BE-SOP-21

Groundwater and LNAPL Measurements

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the procedures and equipment that should be used to determine water levels, depth to floating product, or total depth in a groundwater monitoring well. Groundwater measurements can be used for several purposes during field activities, including but not limited to, measuring changes in time, and determining the magnitude of horizontal and vertical hydraulic gradients in an aquifer system.

A water level meter will typically be used to measure depth to groundwater (DTW), depth to product (DTP), and total depth (TD) in wells. If Light Non-Aqueous Phase Liquid (LNAPL) is present in the well, an oil-water interface probe will be used.

2.0 EQUIPMENT

Groundwater and LNAPL measurement equipment will include:

- Water Level meter with audible alarm and a cable marked in 0.01 foot increments
- Oil-water interface meter (only if LNAPL layer is suspected)
- Decontamination equipment

2.1 DEPTH TO WATER/DEPTH TO LNAPL MEASUREMENT

If the well is sealed with an airtight cap, allow time for the pressure to equilibrate after the cap is removed before measuring water levels. Take measurements until consecutive readings are within 0.01 foot.

Before taking measurements, ensure a reference point is established. For easy reference, mark the point with a permanent surveyor's reference mark, such as a small notch cut into the casing or a permanent ink mark at the top of the casing. If no reference mark is present, mark the north side of the monitoring well casing.

Measure DTW and DTP as follows:

- With the water level indicator switched on, slowly lower the water level meter or oil-water indicator probe down the monitoring well until the probe contacts the groundwater or LNAPL surface, as indicated by the audible alarm. Do not let the probe tip and tape free-fall down the well. Always hold onto the meter's reel handle.
- Raise the probe out of the water or LNAPL until the audible alarm stops. Continue raising and lowering the probe until a precise level is determined within 0.01 foot.

- If LNAPL is present in the well, measure and record the depth from the TOC reference point to the top surface of the LNAPL layer (that is, DTP). The oil-water indicator probe alarm will sound a continuous tone when LNAPL is detected.
- Continue to lower the probe until the meter indicates the presence of groundwater. The alarm will typically emit a beep when water is detected. Measure the first static groundwater level and record the measurement (DTW) from the reference point to the top of the static groundwater level.
- Record the measurements in the field logbook or on the *Well Purge and Sampling Form*.

2.2 TOTAL DEPTH MEASUREMENT

Use the following procedures to measure the TD of a groundwater monitoring well:

- Slowly lower the water level meter until the cable goes slack. Do not let the probe tip and tape free-fall down the well. Always hold onto the meter's reel handle.
- Gently raise and lower the water level meter probe to tap the bottom of the well.
- Record the reading on the cable at the established reference point to the nearest 0.01 foot.

If there is an offset between the bottom of the probe and the water level sensor, adjust the measurement accordingly. Record the TD measurement in the field logbook or on the *Well Purge and Sampling Form*.

STANDARD OPERATING PROCEDURE

BE-SOP-22

Monitoring Well Installation, Development, and Decommissioning

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) is to be used as reference to describe the process for constructing, installing, and developing groundwater monitoring wells provided by a drilling subcontractor via drill-rig operation. This SOP provides a standard set of procedures applicable under typical site conditions and may vary based on actual site conditions and/or equipment characteristics. This SOP is consistent with *Monitoring Well Guidance* issued by the Alaska Department of Environmental Conservation (ADEC 2013). Specific monitoring well design and installation procedures depend on project objectives and subsurface conditions, and should be discussed in the project-specific Work Plan (WP).

Monitoring wells can be installed as long-term monitoring wells, which can be repeatedly sampled over several years, or as temporary well points, which allow for a one-time groundwater sampling event. Following development, purging, and sampling - a temporary well point is usually removed and backfilled in accordance with ADEC regulations.

2.0 EQUIPMENT AND MATERIALS

The drilling subcontractor will supply all materials and equipment necessary to perform drilling activities in accordance with the Drilling and Core Logging SOP (BE-SOP-05) and will install monitoring wells in locations based on field observations, the Statement of Work (SOW), and in the project-specific WP.

Temporary well points are most commonly 1- to 2-inch diameter screened PVC or stainless steel pipe, which can be pre-packed with filter material, or used without a filter pack. Temporary well points can be installed using a direct push drill rig or by hand, if in unconsolidated material with a shallow water table.

Monitoring wells are usually installed with pre-packed screens, using a direct push drill rig or a hollow stem auger.

Equipment and materials needed for monitoring well installation include, but are not limited to, the following:

- Geoprobe® 66 series drill rig or equivalent
- Well casing and screen
- Filter pack materials
- Bentonite
- Surface seal materials (concrete)
- Potable water and/or deionized water
- Weighted tape measure

Monitoring well development equipment includes, but is not limited to the following:

- Water level meter or Oil/Water interface probe
- Surge block (with foot valve)
- Submersible pump
- Sprinkler pump (useful for removing large volumes of silt and fine sand laden water)
- Inertial pump and tubing (optional-consider for deep wells greater than 30 feet)
- Disposable polyethylene or Teflon bailers
- 5-gallon buckets
- Graduated cylinder or beaker
- YSI water-quality meter
- Hach portable turbidity meter
- Potable water and/or deionized water
- Disposable polyethylene tubing

3.0 DOCUMENTATION

Fill out the attached *Well Installation and Well Development Forms* following installation and when developing the monitoring well. All fields on the installation form must be completed for long term monitoring wells as well as temporary well points. All fields on applicable field forms will be used or an "NA" will be inserted to indicate a field that is not applicable. The field form sections are outlined below:

- Well designation;
- Date of well installation;
- Date of development;
- Static water level before and after development;
- Quantity of drilling fluid lost during drilling;
- Well volume;
- Depth from top of well casing to bottom of well;
- Screen length;
- Depth from top of well casing to top of sediment inside well, before and after development, if present;
- Physical characteristics of removed water, including changes during development in clarity, color, particulates, and odor;
- Type and size/capacity of pump and/or bailer used;
- Height of well casing above/below ground surface;
- Typical pumping rate;
- Estimate of recharge rate; and
- Quantity of water removed and time of removal.
- The *Drilling and Core Logging* SOP (BE-SOP-05) will be followed in compliance with the ASTM D2488 Unified Soil Classification standards. The *Core Log* SOP (BE-SOP-05 Attachment) field form must be completed during installation and before leaving the site to ensure all details are captured and are complete and accurate.

- Monitoring wells will be surveyed within a horizontal accuracy of 1.0 feet and a vertical accuracy of 0.01 foot. The top of the well casing will be surveyed as well as ground surface for use as a reference point to determine water-level elevation, sampling depths, and groundwater flow direction. All survey information will be documented in the field log book.

4.0 WELL INSTALLATION PROCEDURES

This section describes drilling, borehole, casing, well screen, bentonite seal, and monitoring well completion requirements.

Prior to monitoring well installation, ADEC recommends developing a conceptual model of the site geology and hydrology. This allows for a better understanding of the distribution of aquifers and aquitards at or near the site, hydrologic boundaries, the water surface table, and other hydrogeographic properties. This is a working model to be updated as new data is obtained.

4.1 DRILLING REQUIREMENTS

Several drilling methods are available for creating a borehole for well installation. Primary methods include hollow stem, direct push, air rotary, mud rotary, and cable tool. The drilling method is chosen based on physical subsurface properties.
All drilling activities will be supervised by a qualified environmental professional. The drill rig will be decontaminated appropriately before it enters and leaves the site in accordance with the *Equipment Decontamination* SOP (BE-SOP-14). All leaks will be repaired prior to coming to the site or as soon as they are discovered at the site. The drill rig will not leak any fluids that may enter the borehole or contaminate equipment placed in the hole. The use of rags or absorbent materials to soak up leaking fluids is unacceptable. Brice, or the drilling subcontractor, will have spill response equipment on site at all times to ensure constant preparedness in the case fluids begin to drip from the rig so they do not impact the site.
Drilling mud, synthetic drilling fluids, petroleum or metal based pipe joint compounds, and other potential contaminants will not be used unless necessary. Only high yield sodium bentonite clay free of organic polymer additives will be used if drilling mud is needed to stabilize the hole.

Decontamination water must be potable and obtained from a known water source.

An “as built” drawing will be constructed for each monitoring well. Each well point will be surveyed.

4.2 BOREHOLE REQUIREMENTS

Borehole diameters should be at least three inches larger than the nominal outside diameter of the casing and well screen. If using a hollow stem auger, the inside diameter of the auger should be at least four inches larger than the nominal outside diameter of the casing and well screen, unless otherwise specified in the approved project-specific Work Plan.

The completed monitoring well must be straight and plumb to allow passage of pumps or sampling devices.

4.3 CASING REQUIREMENTS

The following lists requirements for the casings of monitoring wells:

- All casing will be new, unused, and pre-cleaned (if necessary).
- Glue or solvent will not be used to join casing; casings will be joined only with water-tight flush-joint threads or thermal welds that will not interfere with the planned use of the well.
- Pop rivets or screws should not be used on casings or other monitoring well components.
- All monitoring wells will conform to the American Society for Testing Materials (ASTM) F-480-06b. The inside diameter should be at least 1.9 inches, with the exception of well points for piezometers and transducers. Polyvinyl chloride (PVC) is a durable monitoring well material with good chemical resistance (EPA 1991).
- All metal casing will be seamless stainless steel casing.
- The casing will be straight and plumb within the tolerance stated for the borehole.
- A notch in the top of the casing will be cut to be used as a measuring point for water levels and survey activities. Boring location will be noted based on the identification number.
- The addition of bentonite surrounding the PVC casing will be visually verified during well installation activities to ensure that bridging is not occurring during withdrawal of the drill string/equipment.

4.4 WELL SCREEN REQUIREMENTS

The following are the requirements that must be met for well screens:

- All requirements that apply to casing will also apply to well screen, except for strength requirements.
- Monitoring wells will not be screened across more than one water-bearing unit. Screens will be factory slotted or wrapped.
- Screen slots will be sized to prevent 90 percent of the filter pack from entering the well, and for wells where no filter pack is used, the screen slot size will be selected to retain 60 to 70 percent of the formation materials opposite the screen.
- The bottom of the screen is to be capped, and the cap will be joined to the screen by threads.

In most hydrogeologic settings, screen lengths should not exceed 10 feet. The use of shorter well screens may allow for contaminant detection by reducing excessive dilution.

4.5 FILTER PACK REQUIREMENTS

Surrounding the monitoring well intake with materials that are coarser, of uniform grain size, and have a higher permeability than natural formation material allows the groundwater to flow freely into the well from adjacent formation material while minimizing or eliminating the entrance of fine gained materials. Determine the appropriate filter pack (natural or artificial) application for a given well. An artificial filter pack typically meets these conditions. Deciding between natural and artificial filter pack depends on the grain size distribution of the natural formation materials in the monitored zone. Grain size is determined by conducting a sieve analysis of a soil sample for the intended screened interval. The filter pack should extend above the well screen to a length of 20 % of the well screen length, but no less than 2 feet (ASTM

D5092 2005). The thickness of the filter pack should be at least 2 inches between the borehole and the well screen, and no greater than 8 inches (EPA 1991).

4.6 SEAL REQUIREMENTS

An annular seal should be installed to restrict vertical movement of water or contaminants by sealing the well casing to the adjacent soil formation. The annular seal consists of bentonite chips from the filter pack to approximately 2 feet below the ground surface.

The bentonite seal requirements for wells installed deeper than 12 feet below ground surface, are as follows:

- The bentonite seal will consist of at least two feet of bentonite between the filter pack and the silica sand used to fill the borehole to the ground surface.
- The bentonite will be hydrated after placement.
- Only 100 % sodium bentonite will be used.

The bentonite seal will be terminated 2 feet from the ground surface. The remainder of the annulus will be backfilled using silica sand to minimize bentonite intrusion into the well monument and to promote drainage of water from inside the monument. If the monitoring well is advanced in frozen ground, the annular space between the casing and any permafrost should be sealed to minimize effects on the subsurface thermal regime and to prevent water within the well from freezing.

Seal requirements for wells with submerged screens or screened in deep confined aquifers will be described in the site-specific work plan.

4.7 SOIL BORING AND LOGGING

Soil borings will be logged at each site where monitoring wells will be installed. Refer to BE-SOP-05 for the drilling and core logging procedure.

4.8 MONITORING WELL SURFACE COMPLETION REQUIREMENTS

Surface completion is not necessary for temporary well points.

If flush-mounted completions, cut the casing approximately six inches below the ground surface and provide a water-tight casing cap to prevent surface water from entering the well. A freely draining surface monument with a locking cover should be placed over the casing. The surface monument should be placed in well-sorted sand to allow water drainage. If the well is located on a gravel pad, the top of the monument must be completed at least three inches below pad grade to protect it from snow removal equipment. The top of the casing will be at least one foot above the bottom of the surface monument. The identity of the well should be permanently marked on the monument lid and the casing cap.

For above-ground monitoring well completions, extend the well casing two or three feet above ground surface. Provide a casing cap for each well, and shield the extended casing with a steel sleeve that is placed over the casing and cap and seated in a 3-foot by 3-foot by 4-inch concrete surface pad. To allow for escape of gas, a small diameter (e.g., 1/4-inch) vent hole must be placed in the well casing, or a

ventilated well cap will be used. The diameter of the sleeve should be at least six inches greater than the diameter of the casing. Install a lockable cap or lid on the guard pipe. The identity of the well should be permanently marked on the casing cap and the protective sleeve.

Well locations must be designed to ensure groundwater samples and water level measurements characterize discrete stratigraphic intervals. This is achieved by positioning the screened interval relative to the water table elevation.

Well locations and designs must prevent surface contaminants from entering the groundwater as well as leakage of groundwater or contaminants between the stratigraphic intervals in the well bore or along the well annulus. Complete wells above grade to decrease potential of surface contaminants entering the well.

Install monitoring wells where there is no chance of seasonal inundation by floodwaters, unless the wells have special watertight construction.

Long-term monitoring well development:

- A drilled, long term monitoring well is typically composed of well casing, well screen, and filter pack.
- Place the filter pack into the annulus to a minimum of two feet above the top of the screen and one foot beneath the well endcap.
- Reduce the required filter pack height to allow for annular space sealant.
- Apply bentonite chips to seal the annular space.

5.0 WELL DEVELOPMENT PROCEDURES

Monitoring wells should not be developed for at least 24 hours after installation.

Wells can be developed using a submersible pump, peristaltic pump, and or bailer. Bailers are more commonly used in wells where there is a small volume of water.

Monitoring wells can be developed by first purging the well dry, if possible, then allowing the monitoring well to refill with formation water. If the recovery rate by the formation water is too slow, up to one well casing volume of potable water can be added to the well. The well should be surged vigorously for approximately 10 minutes using either a surge block or bailer. Add more water as necessary. Purge the well dry again to complete the development process (ADEC 2013).

A minimum of three borehole volumes (calculated from the borehole diameter and the length of screen below the water table, corrected for 30 percent porosity of the filter pack) of water and twice the volume of water added during drilling and construction will be removed.

In the event of submerged wells, the borehole volume is calculated over the interval of the filter pack (length of screen plus 2 feet of added sand above the screen).

After initial surging and pumping, groundwater parameters will be monitored for stability criteria (described below).

Groundwater parameter stability is reached when three changes between successive readings at approximately 5-minute intervals at a low-flow pumping rate (drawdown less than 0.3 feet) are less than the criteria provided in Table 1.

Table 1
Stability Criteria for Low-Flow Purging

Parameter[1]	Units	Recording Precision	Stability Criterion
pH	—	0.01	±0.1
Temperature	°C	0.01	±0.2
Conductivity	µS/cm	1	±3%
Turbidity	NTU	0.1	± 10% or ± 1 NTU (whichever is greater)
Oxidation Reduction Potential (ORP)	mV	1	±10
Dissolved Oxygen (DO)	mg/L	0.1	±10% or 0.3 mg/L (whichever is greater)

Notes:
°C – degrees Celsius
µS/cm – microSiemens per centimeter
NTU – nephelometric turbidity units
mV – millivolts
mg/L – milligrams per liter
Stability criteria from ADEC *Field Sampling Guidance* (ADEC 2022).
[1] Only three parameters are required to stabilize, four when using temperature.

Low-yielding wells are exceptions to the above criteria. Such wells should be purged dry, then either be allowed to recover or be filled with potable water to the static water level for surging. Add water as needed to maintain the water level during surging. Satisfactory recovery is defined as 80 percent of the well volume. After the initial recovery period, such wells will be surged and pumped dry again to complete the development process.

Alternative development procedures may be used if they will not affect the ability of the well to provide representative samples. Wells installed with an annular seal must not be developed until 24 hours after well installation to allow annular seal materials to set or cure. ADEC recognizes that remote site work may make this impractical. Contact your ADEC project manager for site-specific approval if development is to be conducted prior to the 24-hour waiting period. Sample the monitoring well in accordance with the ADEC *Field Sampling Guidance* (ADEC January, 2022).

Well purge water can be discharged to the ground surface within 25 feet of the monitoring or recovery well casing, unless there is contamination present, or otherwise specified by the ADEC project manager. If there is evidence of contamination present, the purge water will be remediated based off of the project-specific Work Plan.

A well is considered fully developed when the following criteria are met:

- The well water is clear to the unaided eye (based on observations of water clarity through a clear glass jar); and/or
- If stability cannot be achieved, the well is considered developed when the total volume of water removed from the well equals five times the standing water volume in the well plus the volume of drilling fluid lost or potable water added (if fluids were added).

6.0 WELL DECOMMISSIONING

The purpose of decommissioning monitoring wells and temporary well points is to protect the aquifer. Monitoring wells and temporary well points should be decommissioned as soon as ADEC has determined they are no longer needed. This SOP is consistent with the decommissioning section of the *Monitoring Well Guidance* issued by the Alaska Department of Environmental Conservation (ADEC 2013). Specific monitoring well decommissioning procedures depend on project objectives and subsurface conditions, and must be discussed and presented in the project-specific Work Plan (WP). ADEC approval of the WP is required prior to decommissioning the wells.

1. Knock the bottom of the screen out with a steel drill rod/ pipe, which allows the well to be used as a tremie pipe.
2. Remove the well casing and screen until the screened interval is above the groundwater interface. This allows the material surrounding the well to collapse into the borehole. Keep a 1:1 ratio when pulling out the screen (i.e., if you have a 10-foot screen, pull the well out 10 feet).
3. After the casing is withdrawn above the groundwater interface, add some bentonite chips to the well. Withdraw the casing further and continue adding bentonite chips. Continue this iterative process (pull the casing, fill the borehole, pull the casing, fill the borehole) to within 2 feet of the ground surface.
4. If the well is shallow, add water to hydrate the bentonite chips. Add additional bentonite chips as necessary to seal the well to within 2 feet of the ground surface.
5. If the well is deep, using a grout pump to place a bentonite slurry in the well. The use of the grout pump will ensure complete seal of the borehole and minimize the potential for bridging.
6. If the well is located in a confined aquifer, bentonite chips should begin to be placed within the confining stratum.
7. Fill the remaining 2 feet of the borehole with sand or gravel and restore the site as necessary.
8. Record decommissioning procedures and report to ADEC.

If the well casing and screen are unable to be removed at the time of decommissioning, and it is known that the well construction included a competent annular seal of bentonite chips surrounding the well casing, the screen should be filled with sand and the casing should be completely sealed in-place with bentonite chips up to the casing cutoff point located near the ground surface.

If the monitoring well is damaged, broken, filled or plugged with soil or other extraneous material preventing successful decommissioning efforts by the methods described previously, decommissioning can be achieved by re-drilling the monitoring well. The PVC casing and well screen may be destroyed by re-drilling the original borehole to the total depth of the well. When the auger is at the bottom of the well, bentonite chips should be added continuously as the auger is carefully removed.

7.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2013. *Monitoring Well Guidance.* September.

ADEC. 2022. *Field Sampling Guidance.* January.

ASTM. 2009. *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure.* D2488. West Conshocken, Pennsylvania. July.

U.S. Environmental Protection Agency (EPA). 1991. *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells.* Office of Research and Development.

EPA, Region 4. 2008. *Design and Installation of Monitoring Wells, Science and Ecosystem Support Division.* February.

ATTACHMENTS

Attachment 1 Record of Well Construction

Attachment 2 Well Development Data Sheet

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Record of Well Construction

Project	Project Number	Client	Boring No.

Address, City, State		Drilling Contractor	

Logged by	Date	Started	Drilling Method and Equipment Used
Drill Crew		Completed	

Groundwater Depth	Elevation	Total Depth

Depth (feet)	Diagram	Field Installation Information
1		_____ Surface Monument (material _____)
2		_____ Surface Seal
3		_____ Bentonite Seal
4		_____ Casing (material _____)
5		_____ Screen (material _____)
6		_____ Screen Filter (material _____)
7		_____ Surface Elevation
8		_____ Casing Elevation
9		_____ Casing Stickup
10		_____ Depth of Well
11		_____ Depth of Boring
12		_____ Depth to Groundwater from _____ on (date) _____
		Development Method _____
		Development Time and Purge Volume _____

Record of Well Construction

Field Notes from Drilling

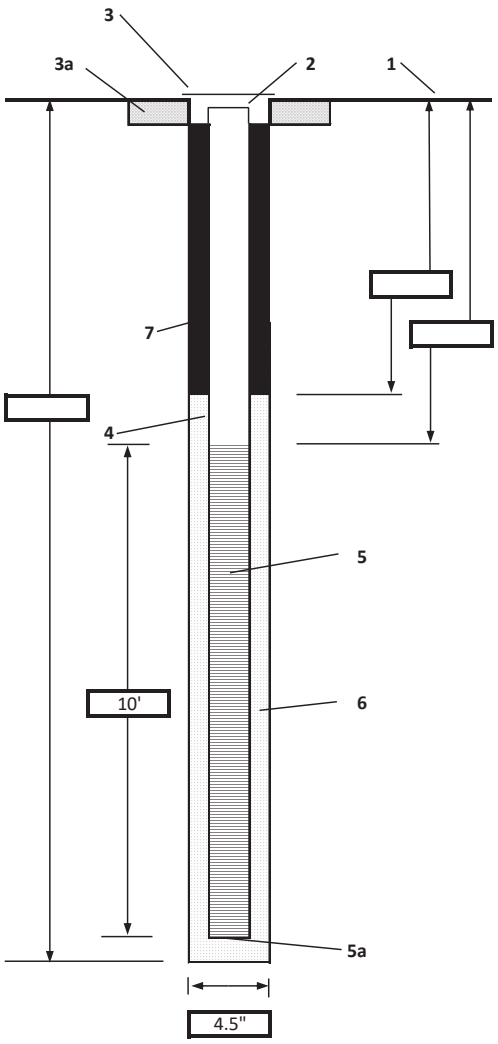
Date	End Time	Start Time
Note-Taker Name		Boring Number
Surface Conditions		

SHEET 1 OF 1

PROJECT NUMBER | WELL ID

FLUSH MOUNT WELL COMPLETION DIAGRAM

PROJECT/CLIENT:	**LOCATION :**
DRILLING CONTRACTOR:	
DRILLING METHOD AND EQUIPMENT USED:	
WATER LEVEL: **START :**	**END :** **LOGGED BY:**



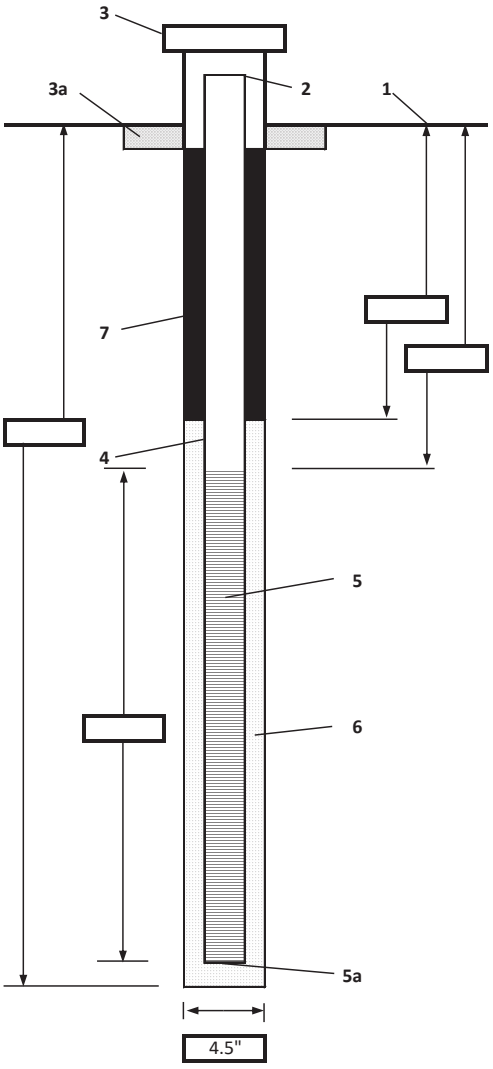
1- Ground elevation at well	TBD
2- Top of casing elevation	TBD
3- Wellhead protection cover type	8" x 12" steel monument
a) concrete pad dimensions	20" diameter
4- Dia./type of well casing	2" Schedule 40 PVC
5- Type/slot/size of screen	2" Schedule 40 PVC 0.010" screen
a) End cap	2" D x 4" L threaded end cone
6- Type of screen filter	Premier Colorado Silica Sand 12/20
7- Type of seal	Baroid Casing Seal
Development method	See Development Sheet
Development time	See Development Sheet
Estimated purge volume	See Development Sheet

Comments

PROJECT NUMBER	SHEET 1 OF 1 WELL ID

RISER WELL COMPLETION DIAGRAM

PROJECT/CLIENT:		**LOCATION :**	
DRILLING CONTRACTOR:			
DRILLING METHOD AND EQUIPMENT USED:			
WATER LEVEL:	**START :**	**END :**	**LOGGED BY:**



1- Ground elevation at well	TBD
2- Top of casing elevation	TBD
3- Wellhead protection cover type	8" x 48" steel riser
a) concrete pad dimensions	20" diameter
4- Dia./type of well casing	2" Schedule 40 PVC
5- Type/slot/size of screen	2" Schedule 40 PVC 0.010" screen
a) End cap	2" D x 4" L threaded end cone
6- Type of screen filter	Premier Colorado Silica Sand 12/20
7- Type of seal	Baroid Casing Seal
Development method	See Development Sheet
Development time	See Development Sheet
Estimated purge volume	See Development Sheet

Comments

WELL DEVELOPMENT FORM

PROJECT NO: **SITE ID:** **WELL ID:** **SHEET of**

PROJECT NAME			
CLIENT		TIME/DATE WELL COMPLETED	
SITE		AS-BUILT TOTAL DEPTH OF WELL (ft BTOC)	
EVENT		CASING MATERIAL AND DIMENSIONS	
DEVELOPER(S)		SCREEN LENGTH (ft) /SCREEN TYPE	
WEATHER/ TEMPERATURE		DEPTH TO TOP FILTER PACK (ft BTOC)/FILTER PACK TYPE	
DATE		DEPTH TO WATER AT TIME OF DRILLING (ft BTOC)	
START TIME		HEIGHT OF WATER COLUMN AT TIME OF DRILLING (ft)	
END TIME		BOREHOLE DIAMETER (in)	
TOTAL PURGE VOLUME		VOLUME OF WATER ADDED DURING DRILLING (gal)	

WELL CONSTRUCTION DATA

BOREHOLE VOLUME FACTORS [BVF]

CASING MATERIAL	CASING I.D. (in)	BOREHOLE DIAMETER (in)	BVF (gal/lin ft)
1" Sch40 PVC	1.049	4.5	**0.279**
2" Sch40 PVC	2.067	4.5	**0.370**
2" Sch40 PVC	2.067	6	**0.563**
2" Sch40 PVC	2.067	8	**0.905**
2" Sch40 PVC	2.067	10	**1.346**
4" Sch40 PVC	4.026	8	**1.246**
4" Sch40 PVC	4.026	10	**1.687**

All BVF calculations assume a filter pack porosity of 0.3.

PRE-PURGE DEVELOPMENT DATA

PURGING EQUIPMENT:
(PUMP TYPE AND MATERIAL, OTHER APPARATUS)

IF PRODUCT IS PRESENT

DEPTH TO PRODUCT (ft FROM TOC):	THICKNESS OF PRODUCT (ft):

PRODUCT DESCRIPTION:

EQUIPMENT DECON PROCEDURE: _____ **PURGE WATER DISPOSAL METHOD:** _____

EQUIPMENT SERIAL NUMBERS: **TURBIDIMETER** **OTHER**

PRE-PURGE WATER COLUMN OBSERVATIONS AND RECOVERY CALCULATIONS

DEPTH TO WATER (ft BTOC)	
TOTAL DEPTH (ft BTOC)	
HEIGHT OF WATER COLUMN (ft)	
80% HEIGHT OF WATER COLUMN (ft)	
80% HEIGHT OF WATER COLUMN (ft BTOC)	
DROWNED SCREEN?	

PURGE VOLUME CALCULATIONS

For screen across the water table: Borehole + Casing Volume (BV) = [Casing Total Depth - Depth to Water] * BVF	For a drowned screen: Borehole + Casing Volume (BV) = [Casing Total Depth - Depth to Top Filter Pack]* BVF	For borehole volume factors (BVF), see uppermost section on the right side of this form, above.

BOREHOLE VOLUME (BV, gal) Calculated using the appropriate formula above.	
MINIMUM PURGE VOLUME (gal) = 2*Volume of Water Added During Drilling + 3*BV	
MAXIMUM PURGE VOLUME (gal) = 2*Volume of Water Added During Drilling + 10*BV	

PURGE DATA

ACTIVITY [SURGE, PURGE, RECOVERY]	TIME	WATER LEVEL (ft BTOC)	DRAW DOWN (ft)	TOTAL DEPTH (ft BTOC)	PURGED VOLUME (gallons or liters)		TURBIDITY (Qualitative or NTU)	NOTES [Flow data: pump intake depth, approximate flowrate, purged dry] [Water quality: color, odor, sheen, sediment in purge water or at TD]
					THIS CYCLE	CUMULATIVE		

WELL DEVELOPMENT FORM

PROJECT NO: **SITE ID:** **WELL ID:** **SHEET of**

ADDITIONAL PURGE DATA

ACTIVITY [SURGE, PURGE, RECOVERY]	TIME	WATER LEVEL (ft BTOC)	DRAW DOWN (ft)	TOTAL DEPTH (ft BTOC)	PURGED VOLUME (gallons or liters)		TURBIDITY (Qualitative or NTU)	NOTES [Flow data: pump intake depth, approximate flowrate, purged dry] [Water quality: color, odor, sheen, sediment in purge water or at TD]
					THIS CYCLE	CUMULATIVE	IDEAL <50 NTU	

STABILIZATION DATA

START TIME: **END TIME:** **TOTAL VOLUME PURGE (GAL):** **STABILITY ACHIEVED: Y / N**

STABILIZATION EQUIPMENT:

(PUMP TYPE AND MATERIAL, OTHER APPARATUS) _____

PURGE WATER DISPOSAL METHOD: _____

EQUIPMENT DECON PROCEDURE:

PUMP INTAKE DEPTH: (ft BTOC or ft BTOW) _____

MAX FLOWRATE: (mL/min or gal/min) _____

STABILIZE DRAWDOWN AT THIS FLOWRATE? _____

DEDICATED TUBING LEFT?

EQUIPMENT SERIAL NUMBERS: **YSI** **TURBIDIMETER** **OTHER**

CONVERSIONS: 1000 mL/min = 0.264 gal/min 1 gal/min = 1893 mL/min 1 gal = 3.785 L 1 L = 0.264 gal

FIELD WATER QUALITY PARAMETERS

TIME	WATER LEVEL (ft BTOC)	DRAW DOWN (ft)	CUMULATIVE PURGED VOLUME (gallons or Liters)	TEMPERATURE (°C or °F)	pH	CONDUCTIVITY (µS/cm)	ORP (mV)	D.O. (mg/L)	TURBIDITY (NTU)	COLOR	ODOR
				± 3% (min ± 0.2°C/0.36°F)	± 0.1	± 3%	± 10 mV	± 10%	± 10% or <10 NTU		

STANDARD OPERATING PROCEDURE

BE-SOP-25

Underground Utility Locates

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the guidelines that will be used during underground utility locates. This SOP will be used to direct field personnel in the techniques and requirements for underground utility identification and clearance.

Underground utility identification and clearance is critical prior to subsurface investigation, drilling, and construction activities. Underground line locations must be known to ensure safe operations. Many states have laws that require all excavators or contractors engaging in subsurface work to notify utility companies at least 48 hours before beginning the work. The location and identification of these lines by the utility companies reduces the contractor's liability should lines be mis-located and damaged during subsurface activities. Underground utility lines are preferential pathways for organic vapor and liquid migration; therefore, knowing their location may aid in the site investigation and remediation processes.

2.0 PROCEDURES

When excavation, trenching, drilling, or other subsurface activities are anticipated, **a project team member must submit notification to the Alaska Digline (811 anywhere in Alaska or 1-800-478-3121)** and local utility companies where applicable. Proposed excavation and soil boring areas should be marked prior to the utility locate. In areas with known utilities, the utility company will conduct a survey of all proposed sample locations for underground utilities. Identified utilities will be marked according to the type of utility present. Typical markings include:

- Red – electric
- Yellow – gas line
- Orange – communication
- Blue – potable water
- Green – sewers and drain lines

Regardless of what method is used to locate underground utilities, never take their exact location for granted. Always begin each excavation and borehole slowly and cautiously, taking care to check for the presence of underground structures, lines, or indicator tape for at least the first three feet of depth; however, note that many utilities may be located deeper than three feet. If the soil is not too hard (i.e. gravelly), hand auger the first three feet of the borehole. Once drilled, check the first three feet with a (non-conductive) probe to make sure that no utilities are present in the sidewall of the borehole. If drilling on active military installations, follow their protocol, which will likely include completion of dig permits and obtaining signatures from facility engineering units.

STANDARD OPERATING PROCEDURE

BE-SOP-51

Material Handling/ Manual Lifting

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the procedures that will be used when material handling/manual lifting at and around a job site.

2.0 GENERAL POLICY

Back injuries are one of the most common and most preventable injuries. After determining an object is within lifting capabilities, warm up by stretching before doing any lifting or strenuous work. Use proper lifting procedures - bend at the knees rather than the waist, and use your leg muscles, not your back. Keep a wide support base by standing with legs hip distance apart, and never twist while lifting. Take proper breaks during repetitive tasks and get help when moving heavy or awkward objects. Use lifting devices when possible. If necessary, have a competent worker or supervisor demonstrate the proper method of bending and lifting.

It is important to identify when materials require lifting equipment, such as slings and chokers, and to determine the proper equipment to assist in lifting the object if manual lifting techniques are not safe.

STANDARD OPERATING PROCEDURE

BE-SOP-52

Driver Safety Program

1.0 INTRODUCTION

This standard operating procedure (SOP) applies to all individuals operating motorized vehicles for work.

2.0 DRIVER SAFETY AND POLICIES

Statistics show that many accidents involve company vehicles. The purpose of this SOP is to avoid injuries, possible loss of life, and costs related to accidents involving company vehicles.

2.1 COMPANY AUTO USAGE POLICIES

The following policies are applicable to company vehicles:

- Company vehicles are for company business only and must be driven by active employees (unless permission is given by a supervisor) who are appropriately licensed, certified, and/or trained for the vehicle that they are operating.
- Vehicles must be maintained in good operating condition. A vehicle inspection form should be completed daily for vehicles used on project sites. Any noted deficiencies should be corrected as soon as possible.
- Drivers must conduct a complete safety walk-around prior to entering the vehicle.
- Occupants must wear seatbelts when vehicles are in motion.
- Vehicles may not be operated while using cell phones. This includes sending or receiving calls, texting, emailing or any other application on the phone. This includes personal vehicles on company business).
- Vehicles are strictly prohibited from use while under the influence of alcohol.
- Vehicles may not be operated while eating or drinking, reading, or using other devices that distract from driving.
- Vehicles must be driven within the laws and regulations for operating motorized vehicles (i.e. valid license, posted speed limits, etc.) and within the manufacturer's operating guidelines.
- Vehicles may not be used to transport alcohol.
- Vehicles must be clean of all garbage, paper, boxes, etc. when no longer in use.
- Smoking is prohibited in company vehicles.
- Vehicle loads must be secured and within the manufacturer's specs and the legal size/weight limits.
- If involved in an accident while on company business, it must be reported to the Safety Officer as soon as possible. All required forms must be completed in a timely manner.

2.2 NEAR MISS POLICY

Company site personnel and subcontractors are required to immediately report all incidents or near misses to their immediate supervisor, SSHO, and/or Site Superintendent. The SSHO/Site Superintendent will evaluate the incident, determine if an emergency exists, and direct response activities as necessary.

If necessary, injured workers will be accompanied to the medical facility by the SSHO or Project Manager for proper case management.

After rendering first aid or summoning emergency services and securing the accident scene, all accidents will be immediately reported as required by the SSHO or Site Superintendent to the Company Project Manager and Company Safety Manager, who will then contact applicable Client Representatives, security personnel, law enforcement or any other involved parties.

The SSHO/Superintendent will then complete and submit an Initial Notice of Incident (and Immediate Report of Accident USACE Form POD 265 for USACE projects) to the Company Safety Manager, Project Manager, and USACE or client representatives within 24-hours of any incident or near miss.

STANDARD OPERATING PROCEDURE

BE-SOP-59

Site Traffic

1.0 INTRODUCTION

This standard operating procedure (SOP) applies to all individuals working in and around roadways while conducting job related activities that may need to set up work zones as protection from vehicular traffic. It also applies to response and recovery workers operating or working near heavy equipment who will need to establish and follow traffic safety procedures to avoid injury and equipment damage.

While OSHA requires that operators be familiar with the pieces of machinery they operate, there is also a need to implement controls to ensure these activities are performed safely. Controls are needed where multiple pieces of heavy equipment, vehicles, and response and recovery workers are in close proximity.

2.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The following PPE is required:

- Hard hat
- Eye protection with side shields
- Gloves appropriate for job hazards expected (e.g., heavy-duty leather work gloves for handling debris with sharp edges and/or chemical protective gloves appropriate for potential chemical contact)
- ANSI-approved protective footwear
- High visibility safety vest

Additional PPE may be warranted depending on site conditions. This evaluation should be made prior to commencing work activities.

3.0 PROTECTING WORKERS FROM VEHICULAR TRAFFIC

When working around traffic, the following should be used to warn oncoming traffic that there are people working in the area:

- Flaggers
- Traffic cones
- Flood Lights
- “Reduce Speed” signs and/or message boards to warn approaching vehicles of the work area

Ensure that the work zone is well lit, but control glare to avoid temporarily blinding passing motorists.

STANDARD OPERATING PROCEDURE

BE-SOP-64

Working with Hand Tools

1.0 INTRODUCTION

This standard operating procedure (SOP) describes safe working practices that should be followed by all individuals working with hand tools.

2.0 GUIDELINES

Hand tools must be kept in proper working order. All tools must be inspected before each use and all employees must be trained to use tools with proper safety.

3.0 TOOL USE

Hand tools will be kept in good condition (undamaged handles and proper working edges) that are not cracked or mushroomed with the potential to chip or create flying objects.

When using hand tools, the tools will:

- Be used within their designated capacity,
- Not be carried or left in a position that could cause injury to employees,
- Be put in storage when work is finished,
- Disconnected from power sources and the pressure in lines released prior to any repair work.

4.0 PERSONAL PROTECTIVE EQUIPMENT

It is critical to use proper personal protective equipment (PPE) when using hand tools. When using hand tools, proper PPE will be implemented:

- Glove selection based on hand tool: leather work gloves versus cut resistant; and
- Safety glasses with side shields

STANDARD OPERATING PROCEDURE

BE-SOP-66

Breathing Zone Air Monitoring

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the guidelines for protection against occupational exposure where potential hazards exist for dust, fumes, mist, radionuclides, toxic gas, vapors, or oxygen deficiency. A Respiratory Protection Program will be implemented in accordance with Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910.134 and USACE's Safety and Health Requirements Manual (USACE 2014).

Breathing zone screening measurements will be periodically collected during activities which warrant air monitoring with a photoionization detector (PID) or colorimetric gas detector tubes to verify that workers are not exposed to contaminants above the levels specified in the project-specific Work Plan. Although not anticipated, if the levels exceed established thresholds, work at the location will be stopped and the respiratory protection program will be updated as necessary.

Downwind locations may also be monitored, as described in the Work Plan.

2.0 MATERIALS AND EQUIPMENT

Air Monitoring Equipment includes but is not limited to:

- PID equipped with a 9.8-, 10.6-, or 11.7-electron volt lamp
- Colorimetric gas detector tubes
- Personal Protective Equipment (PPE)

3.0 PROCEDURE

Under supervision of the site safety and health officer (SSHO), air monitoring will be conducted where contaminant-bearing vapors or dust, lead dust, POLs, or other air-borne contaminants of concern may be present. The project-specific Work Plan will provide air monitoring requirements and action levels for the sites. The type and extent of monitoring will depend upon site-specific conditions and the contaminants encountered at the sites. If a change in conditions is observed at either site, additional air monitoring may be required.

3.1 AIR MONITORING WITH A PID

PIDs should be calibrated daily and tested regularly, as described in the *Field Screening with a PID SOP* (BE-SOP-15).

Prior to PID use, background levels must be established by monitoring outside the exclusion zone or controlled area and upwind of the site.

Once background levels are established, begin taking readings. The PID reads in units of parts per million (ppm), and the readings should be sustained for at least one minute to determine exposure. Record readings on a regular basis. If readings exceed thresholds established in the Work Plan, work will be stopped and the SSHO or superintendent will be notified to determine the appropriate course of action.

3.1.1 Benzene

The PID method is not sensitive enough to detect harmful levels of benzene. If the PID detects organic vapors (readings greater than 1 ppm above background) in the breathing zone at a site where benzene is a known contaminant of concern, the breathing zone shall be tested with a direct reading instrument for benzene. If benzene is detected, personnel will wear passive dosimeters and will modify procedures in accordance with the project-specific Work Plan. The AHAs will also address the required PPE for potential exposure for specific activities. Conditions that exceed project action levels will require an upgrade of PPE until monitoring demonstrates otherwise. The SSHO, with the assistance of trained field personnel, will identify these conditions.

3.2 AIR MONITORING WITH COLORIMETERIC GAS DETECITON TUBES

Instructions for using colorimetric gas detection tubes vary by manufacturer. Always review and follow the manufacturer directions, which are usually printed on the box.

Instructions usually include the following:

- Break both sides of the tube being careful not to puncture or cut skin
- Place the tube in the appropriate pump in the correct orientation. Only use pumps that are in good condition and regularly maintained.
- Draw a fixed volume of gas into the tube. Follow directions to ensure the appropriate volume is being drawn into the tube.
- Wait the appropriate amount of time and then immediately measure the color change. Colors may fade with time.
- Make any humidly or temperature corrections if necessary.
- Record results.

If readings exceed thresholds established in the Site-Specific Health and Safety Plan work will be stopped and the SSHO or superintendent will be notified to determine the appropriate course of action.

4.0 REFERENCES

U.S. Army Corps of Engineers (USACE). 2014 (November). Safety and Health Requirements Manual. EM385-1-1.

APPENDIX D
CONCEPTUAL SITE MODEL

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Print Form

Appendix A - Human Health Conceptual Site Model Scoping Form and Standardized Graphic

Site Name: AKARNG Savoonga Federal Scout Armory

File Number: 670.38.002

Completed by: Brice Engineering, LLC

Introduction

The form should be used to reach agreement with the Alaska Department of Environmental Conservation (DEC) about which exposure pathways should be further investigated during site characterization. From this information, summary text about the CSM and a graphic depicting exposure pathways should be submitted with the site characterization work plan and updated as needed in later reports.

General Instructions: Follow the italicized instructions in each section below.

1. General Information:

Sources *(check potential sources at the site)*

- ☐ USTs
- ☒ ASTs
- ☐ Dispensers/fuel loading racks
- ☒ Drums
- ☐ Vehicles
- ☐ Landfills
- ☐ Transformers
- ☒ Other: Heating oil lines

Release Mechanisms *(check potential release mechanisms at the site)*

- ☒ Spills
- ☒ Leaks
- ☒ Direct discharge
- ☐ Burning
- ☐ Other:

Impacted Media *(check potentially-impacted media at the site)*

- ☒ Surface soil (0-2 feet bgs*)
- ☒ Subsurface soil (>2 feet bgs)
- ☒ Air
- ☐ Sediment
- ☒ Groundwater
- ☒ Surface water
- ☐ Biota
- ☐ Other:

Receptors *(check receptors that could be affected by contamination at the site)*

- ☒ Residents (adult or child)
- ☒ Commercial or industrial worker
- ☒ Construction worker
- ☒ Subsistence harvester (i.e. gathers wild foods)
- ☒ Subsistence consumer (i.e. eats wild foods)
- ☒ Site visitor
- ☒ Trespasser
- ☒ Recreational user
- ☒ Farmer
- ☐ Other:

* bgs - below ground surface

2. Exposure Pathways: *(The answers to the following questions will identify complete exposure pathways at the site. Check each box where the answer to the question is "yes".)*

a) Direct Contact -

1. Incidental Soil Ingestion

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site-specific basis.) ☒

If the box is checked, label this pathway complete: Complete

Comments:

Current and future recreational and subsistence users may potentially ingest soil by consuming fine particles that adhere to skin surfaces, particularly on the hands.

2. Dermal Absorption of Contaminants from Soil

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site specific basis.) ☒

Can the soil contaminants permeate the skin (see Appendix B in the guidance document)? ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

Current and future residents, construction workers, site visitors, trespassers, and subsistence harvesters and consumers may potentially come into contact with soil

b) Ingestion -

1. Ingestion of Groundwater

Have contaminants been detected or are they expected to be detected in the groundwater, or are contaminants expected to migrate to groundwater in the future? ☒

Could the potentially affected groundwater be used as a current or future drinking water source? Please note, only leave the box unchecked if DEC has determined the groundwater is not a currently or reasonably expected future source of drinking water according to 18 AAC 75.350. ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

In the absence of a determination in accordance with 18 AAC 75.350, supra-permafrost porewater could be considered a potential future drinking water source, therefore the ingestion of groundwater is a potentially complete exposure pathway for future receptors. DRO and PAHs have potential to migrate to groundwater.

2. Ingestion of Surface Water

Have contaminants been detected or are they expected to be detected in surface water, or are contaminants expected to migrate to surface water in the future? ☒

Could potentially affected surface water bodies be used, currently or in the future, as a drinking water source? Consider both public water systems and private use (i.e., during residential, recreational or subsistence activities). ☐

If both boxes are checked, label this pathway complete: Incomplete

Comments:

Incidental ingestion of surface water could occur during recreation activities or subsistence harvesting.

3. Ingestion of Wild and Farmed Foods

Is the site in an area that is used or reasonably could be used for hunting, fishing, or harvesting of wild or farmed foods? ☒

Do the site contaminants have the potential to bioaccumulate (see Appendix C in the guidance document)? ☒

Are site contaminants located where they would have the potential to be taken up into biota? (i.e. soil within the root zone for plants or burrowing depth for animals, in groundwater that could be connected to surface water, etc.) ☒

If all of the boxes are checked, label this pathway complete: Complete

Comments:

Contaminants have the potential to bioaccumulate; however, plants do not significantly take up fuel hydrocarbons and therefore this is not considered to be a potential transport mechanism.

c) Inhalation-

1. Inhalation of Outdoor Air

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site specific basis.) ☒

Are the contaminants in soil volatile (see Appendix D in the guidance document)? ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

BTEX compounds have been detected in soil and supra-permafrost porewater at the Savoonga FSRC. Savoonga has a cold climate and most buildings are elevated off the ground surface, which reduces the potential effects of outdoor air inhalation

2. Inhalation of Indoor Air

Are occupied buildings on the site or reasonably expected to be occupied or placed on the site in an area that could be affected by contaminant vapors? (within 30 horizontal or vertical feet of petroleum contaminated soil or groundwater; within 100 feet of non-petroleum contaminted soil or groundwater; or subject to "preferential pathways," which promote easy airflow like utility conduits or rock fractures) ☒

Are volatile compounds present in soil or groundwater (see Appendix D in the guidance document)? ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

Buildings are present at the site and are currently unoccupied, however, may be occupied in the future. Savoonga has a cold climate and most buildings are elevated off the ground surface, reducing the potential effects of indoor air inhalation.

3. **Additional Exposure Pathways:** *(Although there are no definitive questions provided in this section, these exposure pathways should also be considered at each site. Use the guidelines provided below to determine if further evaluation of each pathway is warranted.)*

Dermal Exposure to Contaminants in Groundwater and Surface Water

Dermal exposure to contaminants in groundwater and surface water may be a complete pathway if:

- Climate permits recreational use of waters for swimming.
- Climate permits exposure to groundwater during activities, such as construction.
- Groundwater or surface water is used for household purposes, such as bathing or cleaning.

Generally, DEC groundwater cleanup levels in 18 AAC 75, Table C, are deemed protective of this pathway because dermal absorption is incorporated into the groundwater exposure equation for residential uses.

Check the box if further evaluation of this pathway is needed: ☒

Comments:

Dermal contact with surface water could occur during recreation activities or subsistence harvesting.

Inhalation of Volatile Compounds in Tap Water

Inhalation of volatile compounds in tap water may be a complete pathway if:

- The contaminated water is used for indoor household purposes such as showering, laundering, and dish washing.
- The contaminants of concern are volatile (common volatile contaminants are listed in Appendix D in the guidance document.)

DEC groundwater cleanup levels in 18 AAC 75, Table C are protective of this pathway because the inhalation of vapors during normal household activities is incorporated into the groundwater exposure equation.

Check the box if further evaluation of this pathway is needed: ☒

Comments:

Supra-permafrost porewater could be considered a potential future drinking water source, therefore, there is a complete current or future inhalation of tap water vapor pathway.

Inhalation of Fugitive Dust

Inhalation of fugitive dust may be a complete pathway if:

- Nonvolatile compounds are found in the top 2 centimeters of soil. The top 2 centimeters of soil are likely to be dispersed in the wind as dust particles.
- Dust particles are less than 10 micrometers (Particulate Matter - PM_{10}). Particles of this size are called respirable particles and can reach the pulmonary parts of the lungs when inhaled.

DEC human health soil cleanup levels in Table B1 of 18 AAC 75 are protective of this pathway because the inhalation of particulates is incorporated into the soil exposure equation.

Check the box if further evaluation of this pathway is needed: ☒

Comments:

Soil disturbance could re-suspend dust that may be inhaled rendering this exposure pathway potentially complete. However, it should be noted that under current and likely future conditions, the climate and vegetation minimize this potential exposure pathway.

Direct Contact with Sediment

This pathway involves people's hands being exposed to sediment, such as during some recreational, subsistence, or industrial activity. People then incidentally ingest sediment from normal hand-to-mouth activities. In addition, dermal absorption of contaminants may be of concern if the the contaminants are able to permeate the skin (see Appendix B in the guidance document). This type of exposure should be investigated if:

- Climate permits recreational activities around sediment.
- The community has identified subsistence or recreational activities that would result in exposure to the sediment, such as clam digging.

Generally, DEC direct contact soil cleanup levels in 18 AAC 75, Table B1, are assumed to be protective of direct contact with sediment.

Check the box if further evaluation of this pathway is needed: ☒

Comments:

Current and future receptors could be exposed to chemicals in sediment via incidental ingestion or dermal contact with sediment during recreation activities or subsistence harvesting.

4. Other Comments *(Provide other comments as necessary to support the information provided in this form.)*

HUMAN HEALTH CONCEPTUAL SITE MODEL GRAPHIC FORM

Site: AKARNG Savoonga Federal Scout Armory

Completed By: Brice Engineering, LLC

Date Completed: May 2022

***Instructions*: Follow the numbered directions below. Do not consider contaminant concentrations or engineering/land use controls when describing pathways.**

(1) *Check the media that could be directly affected by the release.*

(2) *For each medium identified in (1), follow the top arrow and check possible transport mechanisms. Check additional media under (1) if the media acts as a secondary source.*

(3) *Check all exposure media identified in (2).*

(4) *Check all pathways that could be complete. The pathways identified in this column **must** agree with Sections 2 and 3 of the Human Health CSM Scoping Form.*

(5) *Identify the receptors potentially affected by each exposure pathway: Enter "C" for current receptors, "F" for future receptors, "C/F" for both current and future receptors, or "I" for insignificant exposure.*

Current & Future Receptors

Media	Transport Mechanisms	Exposure Media	Exposure Pathway/Route	Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
☑ Surface Soil (0-2 ft bgs)	☑ Direct release to surface soil — check soil	☑ soil	☑ Incidental Soil Ingestion	C/F	C/F	C/F	C/F	C/F	C/F	
	☑ Migration to subsurface — check soil		☑ Dermal Absorption of Contaminants from Soil	C/F	C/F	C/F	C/F	C/F	C/F	
	☑ Migration to groundwater — check groundwater		☑ Inhalation of Fugitive Dust	C/F	C/F	C/F	C/F	C/F	C/F	
	☑ Volatilization — check air									
	☑ Runoff or erosion — check surface water									
	☑ Uptake by plants or animals — check biota									
	☐ Other (list):									
☑ Subsurface Soil (2-15 ft bgs)	☑ Direct release to subsurface soil — check soil	☑ groundwater	☑ Ingestion of Groundwater	F	F	F	F	F	F	
	☑ Migration to groundwater — check groundwater		☑ Dermal Absorption of Contaminants in Groundwater	C/F	C/F	C/F	C/F	C/F	C/F	
	☑ Volatilization — check air		☑ Inhalation of Volatile Compounds in Tap Water	F	F	F	F	F	F	
	☑ Uptake by plants or animals — check biota									
	☐ Other (list):									
☑ Ground-water	☑ Direct release to groundwater — check groundwater	☑ air	☑ Inhalation of Outdoor Air	C/F	C/F	C/F	C/F	C/F	C/F	
	☑ Volatilization — check air		☑ Inhalation of Indoor Air	F	F	F	F	F	F	
	☑ Flow to surface water body — check surface water		☑ Inhalation of Fugitive Dust	C/F	C/F	C/F	C/F	C/F	C/F	
	☑ Flow to sediment — check sediment									
	☑ Uptake by plants or animals — check biota									
	☐ Other (list):									
☐ Surface Water	☐ Direct release to surface water — check surface water	☑ surface water	☑ Ingestion of Surface Water	C/F	C/F	C/F	C/F	C/F	C/F	
	☐ Volatilization — check air		☑ Dermal Absorption of Contaminants in Surface Water	C/F	C/F	C/F	C/F	C/F	C/F	
	☐ Sedimentation — check sediment		☐ Inhalation of Volatile Compounds in Tap Water							
	☐ Uptake by plants or animals — check biota									
	☐ Other (list):									
☐ Sediment	☐ Direct release to sediment — check sediment	☑ sediment	☑ Direct Contact with Sediment	C/F	C/F	C/F	C/F	C/F	C/F	
	☐ Resuspension, runoff, or erosion — check surface water									
	☐ Uptake by plants or animals — check biota									
	☐ Other (list):	☑ biota	☐ Ingestion of Wild or Farmed Foods							

APPENDIX E
SITE-SPECIFIC HEALTH AND SAFETY PLAN

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EMERGENCY CONTACT INFORMATION

FIELD	NAME/ASSOCIATION	CONTACT INFORMATION
Emergency		**911**
Clinic	Norton Sound Health Clinic	(907) 984-6756
Hospital (Nome)	Norton Sound Regional Hospital (Nome)	(907) 443-3311
Hospital (Anchorage)	Providence Alaska Medical Center (Anchorage) Providence Emergency Services	(907) 562-2211 (907) 212-3111
Hospital (Anchorage)	Alaska Regional Hospital (Anchorage)	(907) 276-1131
Evacuation	U.S. Coast Guard 17th District	(907) 463-2000
	Guardian Flight (Emergency Flight Service Base in Kotzebue)	(888) 997-3822
	LifeMED Alaska Air Ambulance	(800) 478-5433
	Alaska Regional LifeFlight Air Ambulance (Anchorage)	(800) 478-9111
	Alaska State Troopers: Nome Post	(907) 443-2835
Fuel Spill	Alaska Department of Environmental Conservation Northern Response Team	(907) 451-2121 After hours: (800) 478-9300
Oil and Toxic Chemical Spills	National Response Center	(800) 424-8802
Poison	Poison Control Center	(800) 222-1222
Project Personnel		
USACE Project Manager	Heidi Long	(907) 753-5710 (o)
Project Manager, AKARNG	Jenna Van Horn	(907) 428-7696 (o)
USACE Contracting Officer	Timothy L. Clapp	(907) 753-2836 (o)
USACE Contracting Officer's Representative	Mike Utley	(907) 753-2691 (o)
ADEC Representative	Flannery Ballard	(907) 465-5368 (o)
Brice Project Manager	Monica Oakley	(907) 275-2914 (o) (907) 227-7390 (c)
Brice Field Manager	Monte Garroutte	(907) 750-8688 (c)
Brice Project Engineer/Construction Quality Control System Manager	Kimberly Lloyd	(907) 275-2906 (o) (907) 317-7999 (c)
Brice Project Chemist	Victoria Pennick	(907) 205-9892 (c)
Brice Site Safety and Health Officer	Zachary Rasmussen	(907) 277-2734 (o) (907) 350-6483 (c)
Brice Corporate Safety Officer	Jamey Smith	(503) 539-9504(c)

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1 INCH

WORK PLAN/UFP-QAPP
REMEDIAL ACTION
NATIONAL GUARD FEDERAL
SCOUT ARMORY
SAVOONGA, ALASKA

HOSPITAL ROUTE MAP

LEGEND:

- Norton Sound Regional Hospital (Nome)
- Savoonga - Project Location
- Route to Hospital (Flight Line)

Notes:

1. For conceptual purposes only. All locations are approximate.

References:

1. Map produced using ESRI ArcMap v. 10.7.1.
2. Base imagery from ESRI (WV02, 50cm, 7/11/2014).

ALASKA STATE PLANE ZONE 9
HORIZONTAL DATUM: NAD83 (2011)
VERTICAL DATUM: NAVD88

40 20 0 40
Miles

PROJECT No.:	DATE:	FIGURE:
550501	6/22/2022	E-1
P.M.: MO	DRAWN: JC	

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
ACGIH	American Conference of Government Industrial Hygienists
AED	automated external defibrillator
AHA	Activity Hazard Analysis
AKARNG	Alaska Army National Guard
APP	Accident Prevention Plan
AST	aboveground storage tank
Brice	Brice Engineering, LLC
BTEX	benzene, toluene, ethylbenzene, and xylene
BZ	breathing zone
CFR	Code of Federal Regulations
COPC	contaminants of potential concern
COVID-19	Coronavirus
CPR	cardiopulmonary resuscitation
CSO	corporate safety officer
DRO	diesel range organics
EC	Emergency Coordinator
eV	electron volt
FSA	Federal Scout Armory
GRO	gasoline range organics
HMIS	Hazardous Materials Information System
NFPA	National Fire Protection Association
NPCA	National Paint and Coatings Association
OFR	Office of the Federal Register
PID	photoionization detector
PM	project manager
POL	petroleum, oil, and lubricants
PPE	personal protective equipment
ppm	parts per million
RI	remedial investigation
ROD	record of decision
SDS	Safety Data Sheet
SSHO	site safety and health officer
SSHP	Site Safety and Health Plan
USACE	U.S. Army Corps of Engineers
UTV	utility vehicle

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1.0 INTRODUCTION

This Site Safety and Health Plan (SSHP), prepared by Brice Engineering, LLC (Brice) for the U.S. Army Corps of Engineers (USACE), will serve as the basis for safety and health procedures to be followed during all field activities at the Federal Scout Armory (FSA) in Savoonga, Alaska. The field activities in Savoonga will be conducted as part of the Site Characterization, Records of Decision (ROD), and Remedial Actions for the Alaska Army National Guard (AKARNG) FSAs in Gambell, Savoonga, and Noatak, Alaska under USACE Contract W911KB17D0020. This SSHP complies with Title 29 of the Code of Federal Regulations (CFR) Sections 1910.120 and 1926.65 (29 CFR 1910.120 and 1926.65); and the Office of the Federal Register (OFR) *Hazardous Waste Operations and Emergency Response* (OFR 2005). It was also prepared in compliance with the *USACE Safety and Health Requirements Manual EM-385-1-1* (EM-385-1-1; USACE 2014). As part of this contract, an Accident Prevention Plan (APP) was submitted under separate cover and approved in November 2018.

The primary project objectives at the Savoonga FSA are to remove up to 20 tons of soil containing contaminants of concern greater than the ADEC approved Alternate Cleanup Levels and to collect confirmation soil and porewater samples. This data and supporting information will be compiled from historical records and 2022 field observations to confirm the location of soil contamination.

Below is a list of definable features of work that will be completed as part of the 2022 field effort. These features will be further described in the Savoonga Remedial Action Work Plan and associated appendices.

- Development of a Community Relations Plan in Coordination with AKARNG
- Work Plan Development
- Mobilization and Site Setup
- Remedial Action Activities
  - Impacted soil excavation
  - Confirmation soil sample collection
  - Well Point Installation and Supra-Permafrost Water Sample Collection
- Survey
- Site Restoration and Demobilization
- Waste Management

This SSHP implements health and safety criteria and defines policies and guidelines to be followed for this project. A copy of this SSHP will be kept at the site to be reviewed as needed. Any amendments or required revisions will be made when activities or conditions warrant them. If any contradictions become apparent between this SSHP and any federal, state, or local regulations, the more stringent will apply.

The purpose of this SSHP is to create a site health and safety program that effectively identifies, evaluates, controls, and reduces health and safety hazards. The ultimate objective is to complete the work incident- and injury-free. The field crew and visitors to the site will be held accountable and responsible for working safely and following procedures and guidance set forth in this SSHP. This document must be reviewed, and the Site Safety and Health Plan Acknowledgement sheet signed by all onsite employees who will be working onsite (Attachment E-1 Field Forms).

1.1 Site Description

The Savoonga FSA is a known petroleum-contaminated soil source area, resulting primarily from an estimated 500-gallon heating oil spill to the ground surface from a 3,000-gallon AST. In 1985, 200 gallons of Jet A fuel leaked from drums stored near the AST. In 1992, a leak of an unknown quantity of heating oil from a fuel line. In 1993, two 1,500-gallon ASTs replaced one 3,000-gallon AST near the old FSA building. In 1994, the FSA was deactivated. In 2002, the 3,000-gallon AST near the new FSA was removed and was replaced by the 1,500-gallon AST near the new FSA (Eagle Eye 2017). All three 1,500-gallon ASTs are currently active.

2.0 KEY PERSONNEL AND RESPONSIBILITIES

Key personnel, responsibilities, and contact information are summarized in Table E-1 below.

Table E-1 Key Personnel and Responsibilities

Name	Position	Responsibility
Monica Oakley (907) 227-7390	Brice PM	The PM will oversee implementation of the work activities and health and safety management process. She will ensure site-specific safety procedures are maintained and health and safety goals are implemented, as well as provide the interface between USACE and Brice.
Monte Garroutte (907) 750-8688	Brice Field Manager	This person will coordinate fieldwork activities and ensure onsite personnel comply with this SSHP and have received proper health and safety training.
Zachary Rasmussen (907) 350-6483	Brice SSHO	The SSHO will conduct daily safety meetings and oversee implementation of the SSHP.
Ben Lanich (907) 764-7052	Brice CSO	The CSO will coordinate corporate policy with project SSHO. He will participate in incident investigations, corrective action reporting, and other pertinent reporting as required.

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

3.0 SAVOONGA HAZARD ELEMENTS

The following sections discuss the hazards associated with working at the Savoonga FSA. Prior to conducting any activities, Activity Hazard Analyses (AHA) will be developed with the field team to outline the specific hazards, mitigation measures, and to verify that resources required are available to perform tasks safely. A blank AHA Form is provided in Attachment E-1.

3.1 Site Location

The village of Savoonga is located on a bluff of the northern coast of St. Lawrence Island along the Bering Sea (Figure 2). The Savoonga FSA facility is located 400 feet south of the Bering Sea. Land to the south of Savoonga is hilly and is part of the Kookooligit Mountains. Atuk Mountain lies approximately 8 miles south of the village and rises to an elevation of 2,207 feet. Surface water near Savoonga includes the Bering Sea, the Kitnik River originating in the Kookooligit Mountains located approximately 2 miles east of the village, the Sivuungaq River directly east of the village, and various small lakes and ponds present to the southwest and southeast. East and west of the village, the land consists of bogs on relatively flat land (Ogden 1998).

The primary means of transportation to and from the site is by aircraft, while primary transportation around the village will be by utility vehicle (UTV) or truck. Personnel are not expected to have to be separated; however, the buddy system will be used at all times, and site personnel will be familiar with emergency communication procedures (Section 15.0). First-aid and limited emergency equipment will be available onsite, in addition to the local clinic. In the event of an emergency (non-life-threatening), personnel will go to the Norton Sound Health Clinic in Savoonga for medical attention. In the event of severe emergencies (life-threatening), site workers will call 911 or the Norton Sound Regional Hospital in Nome to request transport to Nome for medical attention.

3.1.1 Earthquakes

Danger from earthquakes exist at the site. If operating equipment or a vehicle, personnel will stop operations and exit the vehicle in a clear area. If working outside, personnel will move to an area free of hazards and wait until the shaking stops. If personnel happen to be indoors and an earthquake hits, they will remain indoors and drop, cover, and stay there. When it is safe to move, all personnel will muster at a site that will be designated by the site safety and health officer (SSHO) prior to beginning fieldwork until the SSHO determines it safe to return to the work site. Before returning to work, personnel will inspect the site and equipment for earthquake-caused hazards. All site personnel will be familiar with emergency procedures, which will be covered at site safety orientations and reviewed periodically during daily tailgate meetings.

3.1.2 Communication

The Village of Savoonga has cellular coverage provided by GCI, therefore, communication will be available via GCI network cell phones. However, due to the remote nature of the village, prior planning and frequent communication between field personnel and the Brice office is vital to ensure onsite personnel safety. The emergency contact list provided at the beginning of this SSHP will be posted in a safe, gathering area onsite.

3.2 Physical Hazards

Physical hazards may cause varying degrees of accidents and/or injuries resulting in medical treatment, damage to equipment, damage to the job site, production delays and a negative impact on morale. The following physical hazards may be encountered while onsite.

Slips, Trips, and Falls: Walking on uneven terrain can be difficult. Although the site is easily accessible and is located in the middle of town, caution must be taken when traversing the site by foot to avoid unnecessary injuries. Upon arrival at the Savoonga FSA site, the field team will carefully walk the site and identify any large hazards. Site hazards, including the specific terrain, will be considered when generating AHAs for project tasks. The buddy system will be maintained during all aspects of work.

Back Strain: Lifting and moving equipment improperly can place a great deal of stress on the back possibly resulting in severe injury. Lifting objects is inherent in performing field investigations; therefore, it is important to use proper lifting techniques. Personnel shall adhere to the following basic rules when performing work that requires lifting:

- If a load is heavy or bulky, get help.
- Remember to lift with your legs and keep your back straight and supported.
- Keep the load as close to your body as you can.
- Do not jerk the load; lift slowly and carefully.

- Make sure the area you will be carrying the load through is clear of obstacles.
- Do not twist or turn your spine when lifting or carrying the load.
- Be sure to have a good grip on your load at all times.
- Be careful when lowering your load (get help, if necessary).

Heat and Cold Stress: The following protocol is to be followed in the event of extreme weather. Temperatures below -15 degrees Fahrenheit (°F) will be referred to as extreme cold weather. Although field activities are generally planned for summer and temperatures are generally not extreme during these times of year, the combination of high wind and precipitation in Alaska can cause extreme cold temperatures year-round. Wind effects on skin and threshold temperatures should be considered when assigning work activities. Efforts will be made to minimize prolonged sitting or standing still in unheated areas. In addition, warm-up areas will be designated when the temperature and/or wind chill drops below -15°F and used at the onset of the following signs and symptoms:

- Heavy shivering
- Frostnip (minor frostbite)
- Feelings of excessive fatigue
- Drowsiness
- Irritability
- Euphoria

The frequency and duration of warm-up time will be dictated by the severity of the exposure to extreme cold conditions. All nonemergency work in unheated spaces should cease if temperatures reach -20°F.

In addition to the extreme cold, site personnel should be prepared for warmer temperatures in case of temperature extremes during field activities. Summer temperatures in Savoonga average 40°F but have been recorded as high as 68°F in nearby Gambell (Western Regional Climate Center, 2021). Field personnel wearing additional PPE during field activities may be more susceptible to heat stress. Additionally, manual labor for extended periods of time may increase the likelihood of heat stress even in mild conditions for some personnel. Four environmental factors affect the amount of stress workers experience in hot work areas: temperature, humidity, sun (radiant heat), and wind. Additional stress levels are associated with age, weight, fitness, medical condition, and acclimation to heat. The symptoms of heat stress include:

- Heat rash (prickly heat)
- Increased heart rate
- Loss of concentration
- Irritability

These symptoms may lead to fainting or death. The following steps are recommended to reduce the risk of heat stress:

- Move to a cooler location.
- Reduce workload or pace.
- Rest in cool areas.
- Wear lightweight clothing.

- Perform more strenuous activities at times during the day when temperatures are cooler.
- Drink plenty of water (one quart per hour).

When ambient air temperature falls below 30°F or rises above 80°F, the SSHO will monitor and provide work/rest regimens to the team. Work/rest regimens may vary depending on the person and will be based on American Conference of Government Industrial Hygienists (ACGIH) guidelines (ACGIH 1999).

Additional information regarding heat and cold stress (including hypothermia) can be found in the corresponding Physical Agent Data Sheets (Attachment E-3).

Noise: Noise may be generated when heavy equipment (e.g., drill rig, UTVs) is used. Hearing protection is mandatory when working in areas where the noise levels exceed 85 decibels (Section 9.0).

Cuts: Materials with sharp edges may be encountered and may pose a potential cutting hazard. Preventive measures shall be taken to prevent cuts and scrapes. Personnel shall wear task-appropriate gloves (e.g., cut-resistant) as part of the PPE requirement (Section 9.0).

3.3 Biological Hazards

The following biological hazards may be encountered onsite:

Bites and Stings: Animal bites and insect stings can cause localized swelling, itching, and minor pain that can be handled by first-aid treatment. In sensitized individuals, however, effects can be more serious. Anaphylactic shock can lead to severe reactions in the circulatory, respiratory, and central nervous systems, and in some cases, even death. The SSHO will identify personnel with a known reaction to bites and stings at the pre-job safety orientation meeting. No attempts should be made to capture any wild or semi-wild animal due to the possibility of a bite or parasitic infection.

Plants: Personnel will be warned to prevent contact with unknown plants. Protective clothing worn by site personnel should reduce the probability of such exposure. Cleaning the skin thoroughly with soap and water after contact will also reduce the risk of severe symptoms. Additionally, personnel will be instructed not to eat unknown berries or plants that they may encounter.

Wildlife: Large animals may be encountered by personnel working in Savoonga as it is in the range of large terrestrial animals, such as brown bears, polar bears, Wolf, and fox. All personnel will be instructed that if a large animal is observed, they shall not approach the animal, but rather retreat inside a vehicle or structure until it leaves the area. Birds may also be encountered. Harassment of wildlife is strictly prohibited.

3.4 Chemical Hazards

Below are the contaminants of potential concern (COPC) that may be present at the site. Detailed information regarding product identification, hazardous components, physical and chemical characteristics, fire and explosion hazard data, reactivity data, health hazards, precautions for safe handling and use, and control measures can be found in the associated safety data sheet (SDS) (Attachment E-2). The SDS for each COPC should be reviewed by every site worker prior to commencing work. Visitors are also required to review each SDS for COPCs present at sites they will be visiting.

COPCs for the Savoonga FSA may include the following:

- DRO
- Residual range organics (RRO)

- Benzene
- Ethylbenzene
- Toluene
- Xylenes
- naphthalene
- 1-methylnaphthalene
- 2-methylnaphthalene

Concentrations of DRO, xylenes, and 1-methylnaphthalene in the soil exceeded ADEC cleanup levels in a previous site investigation, and although there were no other exceedances, gasoline range organics (GRO), RRO, benzene, ethylbenzene, toluene, xylenes, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene, were detected at the site (CH2M HILL 2013). Additional COPCs may be present at the site and should be evaluated as necessary. If any additional contaminants or hazards are expected to be present or identified, an SDS will be provided onsite.

4.0 ACCIDENT PREVENTION

The USACE is committed to ensuring the safety of its employees, contractors, and visitors. Occupational injuries and illnesses can be prevented, controlling exposures to hazardous materials and hazardous work situations, and the prevention of injuries and illnesses are equal in importance to production, quality, cost, and morale. Prior to work each day and before a new phase of a job, safety meetings will be held to review the AHA for the day or for the specific task to be completed. The AHA provides a description of potential hazards and the actions to be taken to eliminate or minimize each of these hazards. Further details on AHAs are provided in Section 6.3 and a blank AHA Form is provided in Attachment E-1.

5.0 EQUIPMENT SAFETY

Safety related to driving, equipment operations, and drill rig operations are described below. Preliminary hazard evaluations for these operations are also presented in Table E-2.

Driving: During onsite activities, the field crew will be operating motorized vehicles (UTVs or truck). These types of motorized vehicles have the potential for serious injuries from rollover accidents, improper operation, exposure to carbon monoxide, pinch points, burns, and crushing hazards. Personnel are to stay alert in areas when operating motorized vehicles and all travel will be completed at safe speeds.

Personnel observed driving recklessly may be removed from the project. Some basic safe driving strategies include:

- Equipment will be operated by trained and qualified personnel.
- Personnel will adhere to proper speed for site conditions.
- Blind corners, curves, and intersections will be approached with caution.
- Vehicles will be properly inspected daily by the operator prior to use.
- Personnel operating project vehicles must have a valid driver's license in their possession, practice defensive driving techniques, and comply with posted speed limits (unless weather conditions dictate slower speeds be maintained).

- Occupants will use seatbelts (if present) while vehicles are in motion.
- Operators and passengers will ride inside of vehicles and wear seatbelts whenever in motion.
- Operators will not use phones in any capacity while project vehicles are in use.
- Vehicles with enclosed cabs should contain, at a minimum, a 5-pound fire extinguisher and first-aid kit.

UTVs will be operated in accordance with Section 18.J of EM-385-1-1 (USACE 2014). These requirements are:

- All operators must have documented training.
- A copy of the operator's manual will be kept with the vehicle at all times.
- UTVs will be equipped with:
  - An operable horn or warning device.
  - Operable brake lights (regardless of light conditions).
  - Operable rear-view mirrors.
  - Operable headlights and taillights (two each), or a yellow flashing light (or equivalent), whenever visibility conditions warrant additional light.
- Occupancy in the UTVs will be limited to manufacturer designated seating.
- The manufacturer's recommended load carrying capacity, personnel capacity, or maximum safe vehicle speed will not be exceeded at any time.
- All items stored as cargo will be secured as necessary.
- All manufacturer-installed safety equipment, including seat belts and anchorages, will be maintained in good working order and will be used appropriately.
- If a windshield is not available or is damaged, operators and passengers shall wear goggles.
- If roll over protection is not provided, operators and passengers will wear approved head protection (conforms to DOT 218 standards).

Drill Rig Operation: During onsite activities, trained and qualified personnel will operate a drill rig. The operation of a drill rig has the potential for mild to serious injuries from operations and site conditions, including pinch points, crushing hazards, and rollover due to uneven terrain. Personnel are to stay alert in areas of operating equipment.

Personnel observed operating the drill rig recklessly may be removed from the project. Some basic safe drill rig operations include:

- Trained and qualified personnel will operate the drill rig.
- Personnel will adhere to established rules for operating and working around a drill rig.

All equipment will be inspected by qualified field personnel and documented in the appropriate Inspection Form. Any deficiencies will be noted and corrected prior to use. If equipment is believed to be unsafe, it will not be operated. A Vehicle Inspection Form and a Drill Rig Inspection Form is provided in Attachment E-1.

Heavy Equipment Operation: The use of heavy equipment is not anticipated, however, if it becomes necessary the use will follow safe operating procedures. Hazards associated with heavy equipment include

roll-overs, collisions, pinch points, and fire. Heavy equipment will be evaluated for suitability of use and physical condition prior to work. Generally, operating equipment will have the right of way.

Listed are some safe work practices to follow when operating or working around heavy equipment:

- Operators must inspect their equipment prior to the start of each shift and document any deficiencies found. This inspection should include brakes, tires, horn, back-up alarm, steering, operating controls, seat belts, and coupling devices.
- Each piece of equipment will have a minimum 5-pound A-B-C portable fire extinguisher.
- Hardhats are to be worn if the equipment is not equipped with a rollover protective structure.
- Functional backup alarms are required on all equipment (unless a spotter is used).
- Digging implements will be in the lowered position when equipment is not in actual use and the parking brake will be set whenever parked. If parked on an incline, wheels must be chocked.
- When equipment is left unattended, power must be shut off, brakes set, digging implements set on ground, and transmission put in park (exception to this is when equipment is idling due to cold weather).

6.0 GENERAL SAFETY

Known and suspected contamination at the site is related to POL in soil and water. The following subsections discuss hazard communication, hazard reporting, AHAs, and stop work authority.

6.1 Hazard Communication

A Hazard Communication Program will be established to inform workers and subcontractors of potential site-specific chemical hazards and comply with the requirements of 29 CFR 1910 and EM-385-1-1 (USACE 2014).

The SSHO will be present at Hazard Communication Program training, which will be provided before starting work and before entering the site. This training will be documented using the Hazard Communication and Right-to-Know Standards form (Attachment E-1).

The purpose of the Hazard Communication Program is to communicate hazards of workplace chemicals and communicate protective measures to control the hazards. Hazard communication is accomplished through the following activities:

- Maintaining a list of all workplace chemicals
- Labeling workplace chemical containers
- Maintaining SDSs for the workplace chemicals and potential workplace chemicals
- Implementing a training program to communicate the hazards of chemicals and appropriate protective measures
- Describing procedures to add SDSs to the site

Upon completion of Hazard Communication Program training, employees and subcontractors will understand the components of hazard communication, the hazards of the chemicals in their workplace, and the protective measures used to control the hazards.

6.1.1 Labels

Labels and other forms of warnings are to be conspicuously placed on containers so that the contents are easily identified. The chemical manufacturer, importer, or distributor will label, tag, or mark the chemical container identifying the hazardous chemicals; the label will include appropriate hazard warnings and the name and address of the chemical manufacturer, importer, or responsible party.

Labeling Systems: There are multiple labeling systems currently in use including the National Fire Protection Association (NFPA) 704M labeling system, Globally Harmonized System, the National Paint and Coatings Association (NPCA) Hazardous Materials Information System (HMIS), the Department of Transportation labeling system, the United Nations Hazard Class Number system and others.

NPCA/HMIS: The NPCA HMIS uses standard labels to communicate hazards with colors, numbers, letters of the alphabet, and symbols. The HMIS is a five-part rectangle that provides identification of the chemical, acute health hazard, flammability, reactivity, PPE designation, and chronic health hazard information. The chemical identity is conveyed by the chemical name and should be the same as the name on the SDS. The acute health (blue), flammability (red), and reactivity (yellow) hazards are communicated by numerical ratings similar to the NFPA system. An alphabetical designation is used to denote recommended PPE. Chronic health hazards may be communicated by placing an asterisk or something similar on the label referencing a specific SDS. The full chronic information may also be written on the label if space allows.

Labels for Transfer Containers: When hazardous materials are transferred from one container to another, the new container will be marked appropriately with the hazard warning.

6.2 Employee Hazard Reporting

Inherent dangers are posed by the jobsite in day-to-day project operations; potential hazards can surface from unexpected events or human error. Brice strives to provide a culture where each employee is alert to hazardous situations and employee involvement is commonplace, and to provide opportunities for the workforce to have a stake in the overall quality of work and product. Employees are encouraged to report observed hazards to their supervisor.

It is important to emphasize:

- Hazard recognition and reporting is everyone's responsibility.
- Site and activity safety is everyone's responsibility.
- Management will respond in a timely and efficient manner.
- Corrective actions will be made known to all employees. The goal is to fix the underlying causes and eliminate the hazards altogether.

6.3 Activity Hazard Analyses

AHAs are required for all tasks. AHAs are used to define the activities to be performed, identify the hazards anticipated with the task, and identify the control measures for the identified hazards, including mitigation resources. As personnel mobilize to the site and encounter actual site conditions, an AHA will be developed to capture actual site conditions and hazards for the activity to verify that protective measures are in place to mitigate hazards. A blank AHA Form is provided in Attachment E-1. In addition, a preliminary hazard evaluation of anticipated activities is presented below in Table E-2.

Table E-2 Preliminary Hazard Evaluation

Activity	Hazards	Mitigation
Mobilization / Demobilization	Cuts/Lacerations/Pinch Points During Packing And Unpacking Of Materials	Wear Cut-Resistant Gloves And Cut Away From The Body.
	Slips, trips, falls	Maintain good housekeeping and keep entrances/exits and pathways clear.
	Back strain/injury	Use proper lifting techniques and use a buddy as needed. Lift boxes/equipment with legs and keep boxes/equipment close to the body.
Driving	Unfamiliar vehicle/unsafe operating condition	Conduct vehicle inspections prior to use. Conduct 360° inspection for obstacles prior operation of the motor vehicle.
	Unfamiliar routes/roads	Drive around the vicinity of the work sites to become familiar with the most effective routes to and from the job site and to and from emergency services.
	Weather/Limited visibility	Adjust speed based on road conditions. Maintain adequate stopping distances.
	Parking/Egress	Consider the easiest exit from the job site when parking the vehicle. Be aware of surroundings (other vehicles, heavy equipment, etc.).
	Vehicle accident/injury	Obey posted speed limits and traffic laws; use defensive driving techniques; be aware of potentially dangerous road conditions and adjust speed accordingly, carry a first-aid kit and fire extinguisher in the vehicle along with a means of communication. Wear seatbelts at all times. Phone use of any kind is not permitted during vehicle operation.
UTV Operation	Rollover, collision, crushing	Maintain speed appropriate for site conditions. Conduct 360° inspection for obstacles prior to operation of the motor vehicle. Wear seat belt and appropriate head protection if no roll cage is present.
Air Travel	Airplane crash/ emergency landing	Dress appropriately for possible exposure to inclement weather. Assess whether the plane appears safe to fly. Follow instructions and maintain 3-points of contact when boarding/deboarding plane. Listen to the safety briefing, ask questions, and locate safety equipment. When applicable, keep cell phones with you during flight.
	Noise	Use hearing protection as necessary.
Site Reconnaissance	Slips, trips, and falls	Maintain good housekeeping.
	Uneven terrain	Be aware of surroundings and thick brush/debris when walking. Wear high-visibility vest, safety-toed boots, safety glasses, and hard hat.
	Working in a rural location	Always work with a buddy and remain aware of increased hazards associated with requiring transport to offsite medical care. Communicate location of muster point prior to beginning work in case of emergency or separation from team members. Pay close attention to location/route; carry project maps and cell phones.
	Wildlife	Observe the area prior to exiting the vehicle. When entering a site, maintain the buddy system and be cautious of surroundings. Communicate observations to project team. Continue to make noise during site activities. Remain in or retreat to vehicles if wildlife is encountered.
	Heat/cold stress	Wear layers. Remain hydrated. Cool down/warm-up breaks.
Survey	Slips, trips, and falls	Maintain good housekeeping.
	Uneven terrain	Wear safety-toed boots and focus on footing.
	Back strain/injury	Use proper lifting techniques and use a buddy as needed. Lift equipment with legs and keep equipment close to the body.

Table E-2 Preliminary Hazard Evaluation

Activity	Hazards	Mitigation
Drilling	Slips, trips, and falls	Maintain good housekeeping.
	Uneven terrain	Wear safety-toed boots and focus on footing. Check drill rig path for safety in areas of uneven terrain.
	Overhead hazards	Travel with the mast down to avoid overhead hazards.
	Airborne debris	Wear safety glasses and hard hat.
	Noise	Wear ear protection.
	Pinch points	Avoid pinch point locations and know where the emergency shutoff button is.
	Visibility	Make eye contact with drill rig operator before approaching rig.
Heavy Equipment Operation	Pinch Points	Avoid pinch point locations and know where the shutoff button is.
	Striking	Achieve eye contact and use proper hand signal with operator before moving in path of excavator.
	Noise	Wear ear protection.
Sampling	Chemical	Wear Level D (or greater) PPE (as applicable).
	Slips, trips, and falls	Maintain good housekeeping.
	Back strain/injury	Use proper lifting techniques and use a buddy as needed. Lift equipment with legs and keep equipment close to the body.
	Glass breakage	Wear gloves when handling glassware, and look in container (box, cooler, etc.) prior to reaching inside.

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

7.0 STOP WORK AUTHORITY

The "Stop Work Authority" is the process by which any Brice employee or subcontractor personnel may stop work activities at the site due to circumstances in the work area, which pose a serious and immediate hazard to an employee's safety or to the environment. In addition, project personnel are authorized to decline to perform an assigned task because of a reasonable belief that under the circumstances the task poses an imminent risk of death or serious bodily harm.

In the event that work is stopped, a review by the SSHO and the corporate safety officer (CSO) is required before restarting associated activities.

8.0 EMPLOYEE TRAINING

Each field crew member will be trained in first-aid/cardiopulmonary resuscitation (CPR), including automated external defibrillator (AED) operation. This training will be consistent with the requirements of a recognized organization (e.g., American Red Cross, American Heart Association, or other certified training programs).

In addition to first-aid/CPR training, our field crew will be current in their Hazardous Waste Operations and Emergency Response training.

9.0 ACCESS CONTROLS

The SSHO will establish the physical boundary of the exclusion zone and will instruct all workers on the limits of any restricted areas when applicable. The site will be marked, and the boundary made clear to

visitors. Because the FSA is in the middle town, visitors/curious residents should be anticipated for this project. Only authorized visitors will be allowed to access the site; visitors will be given the necessary PPE for use during the visit and will be escorted by the SSHO. If any unauthorized persons enter the site, work will be stopped until they are either briefed and given proper PPE or until they leave the site.

At the end of each day, all equipment and supplies will be removed from the site or locked and secured. The drill rig will be secured and left onsite. The site will be left in a safe and secure position when personnel leave each evening.

10.0 PERSONAL PROTECTIVE EQUIPMENT

Employees must be trained for the personal protective equipment (PPE) required for existing or potential hazards. PPE must be inspected prior to use and be maintained in good condition. Damaged PPE will be immediately repaired or replaced.

The level of PPE required is Modified Level D and includes safety-toed boots, high-visibility vests, hard hat, and safety glasses. Prescription glasses must have attached side shields when conditions warrant it. High-visibility apparel must be worn at all sites. Where entanglement hazards of a safety vest are a possibility, other apparel (t-shirt, sweatshirt) with reflective high-visibility materials will be provided.

All employees must use proper gloves for tasks being conducted. The field crew will use task-appropriate work gloves during activities to protect against cuts, abrasions, chemicals, pollutants, etc.

Hearing protection will be used when working in areas where the noise level is 85 decibels or more. This includes power tools or equipment (e.g., drill rig, excavator) that generates loud noise. The crew will follow the three-foot/arm's length rule: if one cannot speak to a fellow employee standing or sitting three feet (or approximately one arm's length) away in a normal tone of voice, the area noise is likely such that hearing protection must be worn. The use of hearing protection will be required during drilling activities.

If required, Modified Level D PPE may be upgraded to Level D or to Level C. Level D PPE includes the addition of Tyvek coveralls. Level C PPE includes the addition of a half-face purifying respirator with organic vapor cartridges. Upgrading the PPE level from Modified Level D is not anticipated during field activities, however, Level C protection (and appropriately trained personnel for the use of a purifying respirator) will be on-hand in case a change in site conditions warrants the upgrade of protection.

11.0 DECONTAMINATION PROCEDURES

Decontamination protects workers, the public, and the environment by limiting exposure to harmful substances and by preventing the spread of contamination. The SSHO will oversee decontamination procedures to determine their effectiveness and will take corrective actions to rectify any deficiencies. Equipment decontamination procedures will be in accordance with BE-SOP-14 *Equipment Decontamination*.

In addition, the following general hygiene decontamination procedures will be followed:

- Remove gloves and place in a waste receptacle.
- Wash hands and face with soap and water or cleaning wipe.
- Wash hands with soap and water prior to eating or drinking.

12.0 WASTE HANDLING AND DISPOSAL

Waste generated onsite from field activities includes investigative-derived waste, PPE, and general trash. Solid non-hazardous waste will be transported offsite for disposal. Decontamination water will be collected in 55-gallon drums, treated through a granulated activated carbon filter, and discharged to the ground surface. Waste management activities will be further discussed in the Work Plan.

13.0 AIR MONITORING

Under supervision of the SSHO, air monitoring will be conducted where potential contaminant vapors may be present. Table E-3 provides air monitoring requirements and action levels. The extent of monitoring will depend upon site-specific conditions and the contaminants encountered at site. If a change in conditions is observed at any time or location, additional monitoring may be required. Breathing zone (BZ) monitoring will be conducted to verify that the field team is using appropriate levels of PPE. Monitoring instruments will be calibrated in accordance with manufacturer instructions. Air monitoring and calibrations will be documented in field logbooks.

Field crews will use a photoionization detector (PID) equipped with a 10.6 electron volt (eV) lamp as the primary method of monitoring. Based on historical monitoring data, the PID is considered protective of site personnel. This method is the most readily available indicator of organic vapors in the atmosphere. Prior to PID use, background levels will be established by monitoring outside the exclusion zone or controlled area and upwind of the site. The PID reads in units of parts per million (ppm), and the readings should be sustained for one minute to determine exposure. The PID BZ action limit will be a reading greater than 10 ppm.

Conditions that exceed action levels in Table E-3 will require an upgrade of PPE until monitoring demonstrates otherwise or work shall be stopped until conditions no longer exceed action levels. The SSHO, with the assistance of trained field personnel, will identify these conditions.

Table E-3 Air Monitoring Requirements and Action Levels

Instrument and Target Gas	Tasks	Action Levels	PPE or Response	Frequency	Calibration
PID for volatile organic compounds (except methane), minimum 10.6 electron-volts, calibrated with isobutylene	All tasks	0 to 25 ppm Breathing Zone	Level D	Monitor the Breathing Zone at the beginning of operations and whenever site conditions change. Levels C and B require continuous monitoring.	Daily
		25 ppm Breathing Zone	Level C; stop work and re-evaluate		
		25 to 50 ppm Breathing Zone	Level C; stop work and re-evaluate		
		>50 ppm Breathing Zone	Level B; stop work and re-evaluate		

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

14.0 DRUG AND ALCOHOL USE

The possession, transportation, and consumption of drugs and alcohol are strictly prohibited on this project, during both working and non-working hours. Being under the influence of drugs or alcohol is not permitted, and any individual suspected to be under the influence of drugs or alcohol will be immediately removed from the work area.

15.0 MEDICAL SURVEILLANCE

All employees participate in a medical surveillance program. This program is initiated when the employee starts work with a complete physical and medical history and is continued on an annual basis. A listing of Brice's worker medical profile for project activities involving hazardous waste (29 CFR 1910.120) is shown in Table E-4.

Table E-4 Worker Medical Profile

Item	Initial	Annual	Item	Initial	Annual
Medical & Work History	•	•	Chest X-ray	•	
Visual Acuity Tests	•	•	Complete Blood Counts	•	•
Pulmonary Function Tests	•	•	Blood Chemistry	•	•
Physical Examination	•	•	Urinalysis	•	•
Audiometer Tests	•	•	Dermatology Examination	•	•

16.0 EMERGENCY PROCEDURES

This section provides for the preparedness of personnel in the event of unplanned fires, explosion, or other emergencies that may cause injury to personnel. This section will be part of the orientation process for new workers.

The muster point location will be determined once the field team has mobilized to Savoonga and site conditions have been assessed. Emergency Contact Information will be maintained in field vehicles and carried by field personnel at all times. Cell phones on the GCI network will be available to field personnel.

16.1 Pre-Emergency Planning and Responsibilities

The Brice SSHO will be the responsible Emergency Coordinator (EC) with the following duties and responsibilities:

- Determine and verify methods of communication and equipment needed (e.g., two-way radios, cell phone, air horn).
- Verify and coordinate methods of transportation of personnel to medical facilities (clinic in Savoonga, hospital in Nome), if needed.
- Ensure that required emergency equipment and materials are readily available.
- Review Plan with employees to ensure coordination of emergency procedures for personal injury, exposures, fires, explosions, and releases.
- Determine safe point of assembly for the site if the need for evacuation arises. If this location changes, personnel will be promptly notified of such changes.

- Review site conditions, operations, and personnel for changes that may affect response procedures.

All personnel have the following responsibilities:

- Review and familiarize the details of the emergency procedures.
- Report any personal medical conditions that could result in medical emergencies.
- Monitor work colleagues and provide assistance as required (e.g., dehydration, heat/cold stress).

16.2 Emergency Equipment and Supplies

The SSHO will ensure that personnel know the locations of emergency response equipment listed below:

- A-B-C Fire Extinguishers – in motorized equipment
- First-Aid Kits – in motor vehicles
- Portable eyewash bottles – in motor vehicles or another accessible location onsite
- Cell phones - with each person or in an identified, safe location

16.3 Emergency Response and Accident Follow-Up

In the case of an earthquake, fire, explosion, or chemical release, the following response sequence will be taken:

- Notify proper emergency response personnel and project management team.
- Notify applicable agencies as necessary.
- Have emergency phone numbers readily available.
- Account for all personnel at designated muster points.
- Assess the need for evacuation and evacuate as conditions dictate.
- In the case of an earthquake, move to designated muster point.
- Submit reports to USACE as required in contract.

A USACE-designated representative will be notified immediately if any of the following events occur:

- A fatal injury
- Permanent total disability
- Permanent partial disability
- One or more persons are admitted to a hospital
- Property damage in the amount of $200,000 or more

Smaller incidents that present minimal safety or health hazards may be controlled with equipment available onsite such as fire extinguishers. **If in doubt, evacuate.**

16.4 Emergency Medical Treatment

When a serious injury has occurred (e.g., severe bleeding, loss of consciousness, difficulty breathing, or heart has stopped), emergency medical treatment is needed. Do the following:

- Call the Esther Barger Memorial Health Clinic immediately for non-life-threatening injuries; for life-threatening injuries, call 911 or the Norton Sound Regional Hospital in Nome to request emergency medical transportation. Emergency Phone Numbers are listed near the front of this document.
- Perform medical and lifesaving treatment, if necessary.
- Secure the area and prevent further injury.
- Notify supervisor, SSHO, and corporate office.
- Ensure injured person is accompanied to the medical center.
- Apply first-aid services, and coordinate follow-up with medical professionals.
- Initiate accident-reporting procedures and submit any required reports to USACE.

16.5 Evacuation

If the SSHO or other competent person determines that emergency medical transportation is warranted, arrangements will be made to fly the individual to the hospital in Nome, depending on the severity of the injury. Once in Nome, the medical team will provide emergency medical care and determine if further transportation to another facility with a higher level of care available is necessary.

Personnel should note that severe weather conditions or other circumstances may delay air evacuation. Due to the length of time to respond in emergency injury situations, it is imperative that all personnel remain alert at all times and avoid accidents and injuries.

When calling for help, provide sufficient information regarding the following:

- Location of the emergency – be as specific as possible about your location
- Events leading to incident – type of emergency
- How many people need help
- What is being done
- **Do not hang up** until instructed to do so

If site evacuation procedures need to be implemented, the steps detailed below will be performed:

- Evacuation routes and muster points will be designated by the EC. These routes and muster points will be communicated to the project team.
- When notification of evacuation is given, all personnel will assemble at designated muster points.
- The EC and a buddy will remain at the site to help direct emergency response personnel.
- The EC will account for all personnel at muster points.
- The evacuation signal, if necessary, will be the continuous sounding of a horn (either a vehicle horn or an air horn).

16.6 Emergency Contact Information

Emergency contact information is included at the beginning of this document. The general area of the muster point locations will be provided at the first Daily Safety Meeting.

17.0 COVID-19 SAFETY PLAN

The Coronavirus (COVID-19) pandemic is a rapidly evolving event. Brice is closely following the Centers for Disease Control and Prevention and applicable government guidelines to help mitigate the spread of COVID-19 to protect the health and safety of our people and continue business operations. There are currently no restrictions for travel to Savoonga, Alaska. Project personnel will adhere to the Brice Personnel COVID-19 Pandemic Guidance Memorandum provided in Attachment E-4. Additionally, the PM and the field team will continually check the State of Alaska website at https://www.travelalaska.com/COVID for specific updates.

18.0 SITE POSTINGS

The following employment-related postings are required and will be available in the field files that will be onsite at all times:

- Copy of this SSHP
- Employee Polygraph Protection Act
- Notice to Employees-Federal Minimum Wage
- You Have A Right to a Safe and Healthful Workplace
- Equal Employment Opportunity is the Law
- The Alaska Human Rights Law & Federal Law Prohibit Sexual Harassment
- Brice Sexual Harassment Policy
- Unemployment Insurance
- Family and Medical Leave Act
- Safety and Health Protection on the Job
- Alaska Wage and Hour Act
- Notice of Insurance
- Uniformed Services Employment and Reemployment Rights Act
- Map denoting route to nearest emergency care facility
- Emergency phone numbers
- OSHA 300A Form
- Copy of deficiency tracking log
- Safety and health promotional posters
- Date of last lost workday injury
- Posting directing workers to location of the SSHP
- Posting directing workers to location of the AHAs and Safe Plans of Action
- Posting directing workers to location of the SDSs
- OSHA Health and Safety Poster

19.0 REFERENCES

American Conference of Government Industrial Hygienists (ACGIH). 1999. *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*.

CH2M HILL. 2013. *Savoonga Federal Scout Readiness Center Data Gap Investigation Report*. Prepared for Alaska Army National Guard. January.

Office of the Federal Register (OFR). 2005. *Hazardous Waste Operations and Emergency Response. National Archives and Records Administration*. 29 CFR 1910.120 and 1926.65. October.

U.S. Army Corps of Engineers (USACE). 2014. *Safety and Health Requirements Manual*. EM-385-1-1. November.

USACE. 2018. *Performance Work Statement, Site Characterization, RODs, and Remedial Actions for the Federal Scout Readiness Centers at Gambell, Savoonga, and Noatak, Alaska*. September

Western Regional Climate Center. 2019. Gambell, Alaska (503226), Period of Record General Climate Summary - Temperature, Period of Record: 9/1/1949 to 8/31/1997. https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?akgamb. Accessed November 2021.

Attachment E-1
Field Forms

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Brice Engineering

ACTIVITY HAZARDS ANALYSIS

Date _____ Project _____

Activity _____

Activity Location _____

Prepared By _____

Overall Risk Assessment Code (RAC) (Use Highest Code)	

Risk Assessment Code (RAC) Matrix

E = Extremely High Risk H = High Risk M = Moderate Risk L = Low Risk		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
SEVERITY	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Add Identified Hazards

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE	RAC

Add Items

EQUIPMENT	TRAINING	INSPECTION

Involved Personnel

NAME	POSITION

Acceptance Authority Signature/Title _____

SITE SAFETY AND HEALTH PLAN ACCEPTANCE

I have had the opportunity to read and ask questions about this Site Safety and Health Plan (SSHP). My signature certifies that I understand the procedures, equipment, and restrictions of this plan and agree to abide by them.

	Name	Signature	Date	Company
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

DAILY VEHICLE INSPECTION CHECKLIST

Client		Project	
		Date (Weekly)	
Vehicle Type		Rental Agency	
Make/Model		Year	
Mileage (start)		Mileage (end)	

	MON		TUE		WED		THUR		FRI		SAT		SUN	
Body and Interior	**Ok**	**Fix**	**Ok**	**Fix**	**Ok**	**Fix**	**Ok**	**Fix**	**Ok**	**Fix**	**Ok**	**Fix**	**Ok**	**Fix**
Inspection Sticker / Registration Tag														
Door Locks / Handles														
Lighting System														
Body and Interior														
Upholstery														
Seatbelts														
Heater/defroster														
Air Conditioner														
Floorboards/Mats														
Paint														
Other:														
PERFORMANCE:														
Brakes / Parking Brake														
Steering														
Operating Condition														
Oil Leak														
Tire Pressure														
Gauges (Pressure/Elect.)														
Fluids														
Other:														

OPERATOR REMARKS:

INFORM MECHANICS OF REPAIRS NEEDED BEFORE OPERATING

DAILY DRILL RIG INSPECTION CHECKLIST

EQ# _____ INSPECTED BY _____

Description _____ FOR WEEK ENDING _____

	MON		TUE		WED		THUR		FRI		SAT		SUN	
EXTERIOR:	**Ok**	**Fix**	**Ok**	**Fix**	**Ok**	**Fix**	**Ok**	**Fix**	**Ok**	**Fix**	**Ok**	**Fix**	**Ok**	**Fix**
STRUCTURE														
TRACKS														
OUTRIGGERS														
FLUIDS (FUEL, HYDRAULIC OIL, ENGINE OIL, COOLANT)														
LEAKS (FUEL,COOLANT, LUBE)														
RADIATOR														
LIGHTS														
BACK UP ALARM														
EMERGENCY SHUTOFF														
FIRE EXT.														
WINCH														
GAUGES/ INDICATOR LIGHTS (PRESSURE/HYDRAULIC OIL/ ENGINE OIL)														
REMOTE CONTROL BOX														

OPERATOR REMARKS:

DAILY SITE SAFETY MEETING

Date	Project	Site Safety and Health Officer

Activities to be Performed	Tools, Equipment, Materials to be Used	Possible Injury, Hazards	Required PPE, Controls, Plan

Name	Signature	Date	Company
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

HAZARD COMMUNICATION

AND

RIGHT-TO-KNOW STANDARD TRAINING FORM

Name: _____

Company: _____

By signing this form I acknowledge and accept the following:

1. I have been instructed about the Hazard Communication Program, Safety Data Sheets (SDS), and Physical Data Sheets (PADS), their use, location and procedures for obtaining copies.
2. I have been informed that some of my work may involve exposure to toxic substances.
3. I have been informed about the right of employees to have access to relevant exposure and medical records, and the procedures for requesting access.
4. I understand the employer must act upon a request in a reasonable amount of time to avoid the interruption of normal work operations but within 15 days.

Signature: _____

Date: _____

STANDARD OPERATING PROCEDURE

BE-SOP-14

Equipment Decontamination

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for decontamination of reusable equipment.

2.0 MATERIALS

Materials used for decontamination may include:

- Level D Personal Protective Equipment (PPE) – nitrile or rubber gloves, safety glasses, safety toed boots, hard hat and safety vest (if decontaminating drilling or heavy equipment)
- Hand tools for bulk contamination removal (shovels, brooms, etc.)
- Liquinox or Alconox
- Spray or rinse bottles, or pump sprayer
- Pressure washer/steam cleaner
- Potable water
- Distilled or deionized water
- Bristle brushes
- Plastic tubs
- Plastic sheeting
- Department of Transportation (DOT)-approved, 5-gallon buckets with screw top lids
- DOT-approved, 55-gallon open-top drums
- Contractor-grade plastic bags
- Paper towels

3.0 PROCEDURE

Reusable sampling equipment must be decontaminated between samples and at the end of each workday. Drilling and excavation equipment should be decontaminated prior to beginning site activities, before collecting each sample when non-dedicated sampling equipment is used, and after completing site activities. Decontamination procedures are detailed in the following subsections.

3.1 DECONTAMINATION AREA

Identify a localized decontamination area for larger drilling and excavation equipment. Select an area with easy access and level ground to minimize slip, trip, and fall hazards. The decontamination area should be large enough to temporarily store clean equipment and materials. When decontaminating larger drilling tooling, such as hollow-stem augers, line each area with a heavy-gauge plastic sheeting and include a

collection system designed to capture potential decontamination wastes (water and residual soil). Containerize decontamination water and residual soil in approved containers, such as DOT-approved 55-gallon drums, before treating/disposing the water and residual soil as specified in the approved project-specific Work Plan. Decontamination areas should be set up to minimize overspray and risk to the surrounding environment.

Smaller equipment (spoons, trowels, groundwater sampling pumps, etc.) may be decontaminated near the sampling locations. In this case, all required decontamination supplies must be mobilized to the sampling location. A 5-gallon bucket with a screw top lid or a plastic tub should be used to capture decontamination water, which should be transferred to larger containers, as necessary.

3.2 SAMPLING EQUIPMENT DECONTAMINATION

Improper decontamination can cause cross-contamination. To prevent cross-contamination, sampling equipment must be either disposed of after one use or decontaminated after each use. Disposable or dedicated sampling equipment should be used whenever possible. When non-dedicated, reusable equipment is used, it should be decontaminated in stages in a way that minimizes contaminant discharge to the environment. The following procedures should be used:

1) Remove as much bulk contamination as possible from equipment at the point of origin.
2) Wash equipment thoroughly with potable water containing a laboratory-grade detergent, such as Liquinox or Alconox. Use a bristle brush to remove any remaining residual contamination.
3) Rinse equipment thoroughly with potable water.
4) Rinse equipment thoroughly with distilled or deionized water. Note that some instruments can be damaged by deionized water, such as YSI 556 and Aqua TROLL 500 probes.
5) Air dry equipment in clean area free of dust or other fugitive contaminants. Alternatively, wet equipment may be dried with a clean, disposable paper towel to assist the drying process. All equipment should be dry before reuse.
6) Store clean and dry sampling equipment within a protective medium (plastic bag, carrying case, etc.).

3.3 HEAVY EQUIPMENT DECONTAMINATION

Equipment decontamination must be performed prior to transporting or walking equipment between contaminated areas. Decontamination will focus on minimizing the spread of contaminated media resulting from equipment movement or transport. This decontamination process will use dry methods (brooms, brushes, shovels, etc.) within the exclusion zone to remove large, easily dislodged deposits of soil and other contaminated media from equipment (tracks, buckets, etc.) prior to exiting the exclusion zone. The Field Lead may alter decontamination procedures based on dry decontamination effectiveness.

Final decontamination should be conducted when equipment is no longer needed onsite. A decontamination area should be established to collect decontamination materials, sludge, and water. Bulk contamination should be removed using shovels and brushes, and the equipment should be further cleaned using a pressure washer with a detergent wash, followed by a potable water rinse, if needed.

3.4 PERSONNEL AND PERSONAL PROTECTIVE EQUIPMENT DECONTAMINATION

During environmental investigations and removal actions, boots and gloves are commonly the most contaminated types of PPE. Contaminated solids such as mud should be scraped and wiped from boots. Personnel decontamination involves removal of bulk contamination first. Any remaining contamination should be removed using soapy water and brushes. Once all debris is removed, rinse the boots with clean water. If boots are not laden with solid materials, a brush can be used to knock off or remove any residual solid materials. If the boots have contacted liquid-phase contaminants, it is important that the contaminants be removed using soapy water and a brush, followed by a clean water rinse. If the contaminants have adsorbed into the boots, the boots must be replaced. Gloves should be removed rolling the glove off from the top down to avoid contact with contaminated soil.

Following removal and cleaning of reusable PPE, field personnel should wash their hands or any exposed body parts which may have been in contact with the associated contaminated substances.

4.0 INVESTIGATION-DERIVED WASTE MANAGEMENT

Typical investigation-derived wastes (IDW) consist of soil cuttings, decontamination water, and solid wastes. Wastes will be managed based on media type following the procedures specified in the Alaska Department of Environmental Conservation -approved project-specific Work Plan and in accordance with the federal, state, and local regulations. Typical methods of managing IDW are described in the *Waste Management* SOP (BE-SOP-79).

5.0 QUALITY CONTROL

Quality Control (QC) samples may be collected to verify that the decontamination process is effective. QC samples include equipment rinsate blanks and equipment wipe samples, which are described in the *Quality Control Samples* SOP (BE-SOP-04).

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Attachment E-2
Safety Data Sheets

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ALCONOX MSDS

Section 1 : MANUFACTURER INFORMATION

Product name: Alconox

Supplier: Same as manufacturer.

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Manufacturer emergency phone number: 800-255-3924.
813-248-0585 (outside of the United States).

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Supplier MSDS date: 2005/03/09

D.O.T. Classification: Not regulated.

Section 2 : HAZARDOUS INGREDIENTS

C.A.S.	CONCENTRATION %	Ingredient Name	T.L.V.	LD/50	LC/50
25155-30-0	10-30	SODIUM DODECYLBENZENESULFONATE	NOT AVAILABLE	438 MG/KG RAT ORAL 1330 MG/KG MOUSE ORAL	NOT AVAILABLE
497-19-8	7-13	SODIUM CARBONATE	NOT AVAILABLE	4090 MG/KG RAT ORAL 6600 MG/KG MOUSE ORAL	2300 MG/M3/2H RAT INHALATION 1200 MG/M3/2H MOUSE INHALATION
7722-88-5	10-30	TETRASODIUM PYROPHOSPHATE	5 MG/M3	4000 MG/KG RAT ORAL 2980 MG/KG MOUSE ORAL	NOT AVAILABLE
7758-29-4	10-30	SODIUM PHOSPHATE	NOT AVAILABLE	3120 MG/KG RAT ORAL 3100 MG/KG MOUSE ORAL >4640 MG/KG RABBIT DERMAL	NOT AVAILABLE

Section 2A : ADDITIONAL INGREDIENT INFORMATION

Note: (supplier).
CAS# 497-19-8: LD50 4020 mg/kg - rat oral.
CAS# 7758-29-4: LD50 3100 mg/kg - rat oral.

Section 3 : PHYSICAL / CHEMICAL CHARACTERISTICS

Physical state: Solid

Appearance & odor: Almost odourless.
White granular powder.

Odor threshold (ppm): Not available.

Vapour pressure (mmHg): Not applicable.

Vapour density (air=1): Not applicable.

By weight: Not available.

Evaporation rate (butyl acetate = 1): Not applicable.

Boiling point (°C): Not applicable.

Freezing point (°C): Not applicable.

pH: (1% aqueous solution).
9.5

Specific gravity @ 20 °C: (water = 1).
0.85 - 1.10

Solubility in water (%): 100 - > 10% w/w

Coefficient of water\oil dist.: Not available.

VOC: None

Section 4 : FIRE AND EXPLOSION HAZARD DATA

Flammability: Not flammable.

Conditions of flammability: Surrounding fire.

Extinguishing media: Carbon dioxide, dry chemical, foam.
Water
Water fog.

Special procedures: Self-contained breathing apparatus required.
Firefighters should wear the usual protective gear.

Auto-ignition temperature: Not available.

Flash point (°C), method: None

Lower flammability limit (% vol): Not applicable.

Upper flammability limit (% vol): Not applicable.

Not available.

Sensitivity to mechanical impact: Not applicable.

Hazardous combustion products: Oxides of carbon (COx).
Hydrocarbons.

Rate of burning: Not available.

Explosive power: None

Section 5 : REACTIVITY DATA

Chemical stability: Stable under normal conditions.

Conditions of instability: None known.

Hazardous polymerization: Will not occur.

Incompatible substances: Strong acids.
Strong oxidizers.

Hazardous decomposition products: See hazardous combustion products.

Section 6 : HEALTH HAZARD DATA

Route of entry: Skin contact, eye contact, inhalation and ingestion.

Effects of Acute Exposure

Eye contact: May cause irritation.

Skin contact: Prolonged contact may cause irritation.

Inhalation: Airborne particles may cause irritation.

Ingestion: May cause vomiting and diarrhea.
May cause abdominal pain.
May cause gastric distress.

Effects of chronic exposure: Contains an ingredient which may be corrosive.

LD50 of product, species & route: > 5000 mg/kg rat oral.

LC50 of product, species & route: Not available for mixture, see the ingredients section.

Exposure limit of material: Not available for mixture, see the ingredients section.

Sensitization to product: Not available.

Carcinogenic effects: Not listed as a carcinogen.

Reproductive effects: Not available.

Teratogenicity: Not available.

Mutagenicity: Not available.

Synergistic materials: Not available.

Medical conditions aggravated by exposure: Not available.

First Aid

Skin contact: Remove contaminated clothing.
Wash thoroughly with soap and water.
Seek medical attention if irritation persists.

Eye contact: Check for and remove contact lenses.
Flush eyes with clear, running water for 15 minutes while holding eyelids open: if irritation persists, consult a physician.

Inhalation: Remove victim to fresh air.
Seek medical attention if symptoms persist.

Ingestion: Dilute with two glasses of water.
Never give anything by mouth to an unconscious person.
Do not induce vomiting, seek immediate medical attention.

Section 7 : PRECAUTIONS FOR SAFE HANDLING AND USE

Leak/Spill: Contain the spill.
Recover uncontaminated material for re-use.
Wear appropriate protective equipment.
Contaminated material should be swept or shoveled into appropriate waste container for disposal.

Waste disposal: In accordance with municipal, provincial and federal regulations.

Handling procedures and equipment: Protect against physical damage.
Avoid breathing dust.
Wash thoroughly after handling.
Keep out of reach of children.
Avoid contact with skin, eyes and clothing.
Launder contaminated clothing prior to reuse.

Storage requirements: Keep containers closed when not in use.
Store away from strong acids or oxidizers.
Store in a cool, dry and well ventilated area.

Section 8 : CONTROL MEASURES

Precautionary Measures

Gloves/Type:



Neoprene or rubber gloves.

Respiratory/Type:



If exposure limit is exceeded, wear a NIOSH approved respirator.

Eye/Type:



Safety glasses with side-shields.

Footwear/Type: Safety shoes per local regulations.

Clothing/Type: As required to prevent skin contact.

Other/Type: Eye wash facility should be in close proximity.
Emergency shower should be in close proximity.

Ventilation requirements: Local exhaust at points of emission.

Safety Data Sheet

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

Material Name	:	**Diesel (ULSD/Gasoil)**
Recommended Use / Restrictions of Use	:	Fuel for on-road diesel-powered engines. Fuel for use in off-road diesel engines, boilers, gas turbines and other combustion equipment.
Supplier	:	**Shell Eastern Trading (PTE) Ltd** 9 North Buona Vista Drive, #07-01, Tower 1, The Metropolis Singapore 138588 Singapore
Telephone	:	+65-6384 8000
Emergency Telephone Number	:	+44 (0) 151 350 4595

2. HAZARDS IDENTIFICATION

GHS Classification	:	Flammable liquids, Category 3 Aspiration hazard, Category 1 Acute toxicity, Category 4, Inhalation Skin corrosion/irritation, Category 2 Carcinogenicity, Category 2 Specific target organ toxicity - repeated exposure, Category 2, Blood., Thymus., Liver Hazardous to the aquatic environment - Long-term Hazard, Category 2 Acute hazards to the aquatic environment, Category 2
GHS Label Elements Symbol(s)	:	
Signal Words	:	Danger
Hazard Statement	:	PHYSICAL HAZARDS: H226: Flammable liquid and vapour. HEALTH HAZARDS:

H304: May be fatal if swallowed and enters airways.
H315: Causes skin irritation.
H332: Harmful if inhaled.
H351: Suspected of causing cancer.
H373: May cause damage to organs or organ systems through prolonged or repeated exposure.

ENVIRONMENTAL HAZARDS:
H411: Toxic to aquatic life with long lasting effects.
H401: Toxic to aquatic life.

GHS Precautionary Statements

Prevention : P210: Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P261: Avoid breathing dust/fume/gas/mist/vapours/spray.
P280: Wear protective gloves/protective clothing/eye protection/face protection.

Response : P301+P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
P331: Do NOT induce vomiting.

Disposal: : P501: Dispose of contents and container to appropriate waste site or reclaimer in accordance with local and national regulations.

Other Hazards which do not result in classification : Vapour in the headspace of tanks and containers may ignite and explode at temperatures exceeding auto-ignition temperature, where vapour concentrations are within the flammability range.
May ignite on surfaces at temperatures above auto-ignition temperature.
This material is a static accumulator. Even with proper grounding and bonding, this material can still accumulate an electrostatic charge. If sufficient charge is allowed to accumulate, electrostatic discharge and ignition of flammable air-vapour mixtures can occur.

Additional Information : This product is intended for use in closed systems only.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Mixture Description : Complex mixture of hydrocarbons consisting of paraffins, cycloparaffins, aromatic and olefinic hydrocarbons with carbon

numbers predominantly in the C9 to C25 range. May also contain several additives at <0.1% v/v each. May contain cetane improver (Ethyl Hexyl Nitrate) at <0.2% v/v.

May contain catalytically cracked oils in which polycyclic aromatic compounds, mainly 3-ring but some 4- to 6-ring species are present.

Classification of components according to GHS

Chemical Identity	Synonyms	CAS	Hazard Class (category)	Hazard Statement	Conc.
Fuels, diesel	Fuels, diesel	68334-30-5	Flam. Liq., 3; Asp. Tox., 1; Acute Tox., 4; Skin Corr., 2; Carc., 2; STOT RE, 2; Aquatic Chronic, 2; Aquatic Acute, 2;	H226; H304; H332; H315; H351; H373; H411; H401;	60.00 - 100.00 %
Distillates (Fischer-Tropsch) C8-26 - Branched and Linear	Distillates (Fischer-Tropsch) C8-26 - Branched and Linear	848301-67-7	Asp. Tox., 1; Flam. Liq., 4;	H304; H227;	0.00 - 30.00 %
Kerosine (Fischer Tropsch), Full range, C8-C16 branched and linear alkanes	Kerosine (Fischer Tropsch), Full range, C8-C16 branched and linear alkanes	848301-66-6	Asp. Tox., 1; Flam. Liq., 3;	H304; H226;	0.00 - 10.00 %

Additional Information : Dyes and markers can be used to indicate tax status and prevent fraud. Contains Cumene, CAS# 98-82-8 Contains Naphthalene, CAS # 91-20-3.

Refer to Ch 16 for full text of H phrases.

4. FIRST-AID MEASURES

Inhalation : Remove to fresh air. If rapid recovery does not occur, transport to nearest medical facility for additional treatment.

Skin Contact : Remove contaminated clothing. Immediately flush skin with

		large amounts of water for at least 15 minutes, and follow by washing with soap and water if available. If redness, swelling, pain and/or blisters occur, transport to the nearest medical facility for additional treatment. When using high pressure equipment, injection of product under the skin can occur. If high pressure injuries occur, the casualty should be sent immediately to a hospital. Do not wait for symptoms to develop.
Eye Contact	:	Flush eye with copious quantities of water. If persistent irritation occurs, obtain medical attention.
Ingestion	:	If swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment. If vomiting occurs spontaneously, keep head below hips to prevent aspiration. If any of the following delayed signs and symptoms appear within the next 6 hours, transport to the nearest medical facility: fever greater than 101° F (38.3°C), shortness of breath, chest congestion or continued coughing or wheezing. Give nothing by mouth.
Most Important Symptoms/Effects, Acute & Delayed	:	If material enters lungs, signs and symptoms may include coughing, choking, wheezing, difficulty in breathing, chest congestion, shortness of breath, and/or fever. The onset of respiratory symptoms may be delayed for several hours after exposure. Skin irritation signs and symptoms may include a burning sensation, redness, or swelling.
Immediate medical attention, special treatment	:	Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

Specific hazards arising from Chemicals	:	Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Oxides of sulphur. Unidentified organic and inorganic compounds. Carbon monoxide may be evolved if incomplete combustion occurs. Will float and can be reignited on surface water. Flammable vapours may be present even at temperatures below the flash point. The vapour is heavier than air, spreads along the ground and distant ignition is possible.
Suitable Extinguishing Media	:	Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
Unsuitable Extinguishing Media	:	Do not use direct water jets on the burning product as they could cause a steam explosion and spread of the fire. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

Protective Equipment & Precautions for Fire Fighters	:	Proper protective equipment including chemical resistant gloves are to be worn; chemical resistant suit is indicated if large contact with spilled product is expected. Self-Contained Breathing Apparatus must be worn when approaching a fire in a confined space. Select fire fighter's clothing approved to relevant Standards (e.g. Europe: EN469).
Additional Advice	:	Keep adjacent containers cool by spraying with water. If possible remove containers from the danger zone. If the fire cannot be extinguished the only course of action is to evacuate immediately. Contain residual material at affected sites to prevent material from entering drains (sewers), ditches, and waterways.

6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. See Chapter 13 for information on disposal. Observe the relevant local and international regulations. Evacuate the area of all non-essential personnel. Ventilate contaminated area thoroughly. Take precautionary measures against static discharges.

Personal Precautions, Protective Equipment and Emergency Procedures	:	Do not breathe fumes, vapour. Do not operate electrical equipment. Shut off leaks, if possible without personal risks. Remove all possible sources of ignition in the surrounding area and evacuate all personnel. Attempt to disperse the gas or to direct its flow to a safe location for example by using fog sprays. Take precautionary measures against static discharge. Ensure electrical continuity by bonding and grounding (earthing) all equipment. Monitor area with combustible gas meter.
Environmental Precautions	:	Take measures to minimise the effects on groundwater. Contain residual material at affected sites to prevent material from entering drains (sewers), ditches, and waterways. Prevent from spreading or entering into drains, ditches or rivers by using sand, earth, or other appropriate barriers.
Methods and Material for Containment and Cleaning Up	:	Take precautionary measures against static discharges. For small liquid spills (< 1 drum), transfer by mechanical means to a labelled, sealable container for product recovery or safe disposal. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely. For large liquid spills (> 1 drum), transfer by mechanical means such as vacuum truck to a salvage tank for recovery or safe disposal. Do not flush away residues with water. Retain as contaminated waste. Allow residues to evaporate or soak up with an appropriate

absorbent material and dispose of safely. Remove contaminated soil and dispose of safely. Shovel into a suitable clearly marked container for disposal or reclamation in accordance with local regulations.

Additional Advice : Notify authorities if any exposure to the general public or the environment occurs or is likely to occur. Local authorities should be advised if significant spillages cannot be contained. Maritime spillages should be dealt with using a Shipboard Oil Pollution Emergency Plan (SOPEP), as required by MARPOL Annex 1 Regulation 26.

7. HANDLING AND STORAGE

General Precautions : Avoid breathing vapours or contact with material. Only use in well ventilated areas. Wash thoroughly after handling. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material. Air-dry contaminated clothing in a well-ventilated area before laundering. Prevent spillages. Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Never siphon by mouth. Contaminated leather articles including shoes cannot be decontaminated and should be destroyed to prevent reuse.
Maintenance and Fuelling Activities - Avoid inhalation of vapours and contact with skin.

Precautions for Safe Handling : Avoid inhaling vapour and/or mists. Avoid prolonged or repeated contact with skin. When using do not eat or drink. Extinguish any naked flames. Do not smoke. Remove ignition sources. Avoid sparks. Earth all equipment. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires. Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. The vapour is heavier than air, spreads along the ground and distant ignition is possible.

Conditions for Safe Storage : Drum and small container storage: Drums should be stacked to a maximum of 3 high. Use properly labelled and closeable containers. Tank storage: Tanks must be specifically designed for use with this product. Bulk storage tanks should be diked (bunded). Locate tanks away from heat and other sources of ignition. Must be stored in a diked (bunded) well-ventilated area, away from sunlight, ignition sources and other sources of heat. Vapours from tanks should not be released to

atmosphere. Breathing losses during storage should be controlled by a suitable vapour treatment system. The vapour is heavier than air. Beware of accumulation in pits and confined spaces. Keep container tightly closed and in a cool, well-ventilated place. Keep in a cool place. Electrostatic charges will be generated during pumping. Electrostatic discharge may cause fire. Ensure electrical continuity by bonding and grounding (earthing) all equipment to reduce the risk. The vapours in the head space of the storage vessel may lie in the flammable/explosive range and hence may be flammable. Refer to section 15 for any additional specific legislation covering the packaging and storage of this product. Keep in a bunded area with a sealed (low permeability) floor, to provide containment against spillage. Prevent ingress of water.

Product Transfer : Avoid splash filling. Wait 2 minutes after tank filling (for tanks such as those on road tanker vehicles) before opening hatches or manholes. Wait 30 minutes after tank filling (for large storage tanks) before opening hatches or manholes. Keep containers closed when not in use. Contamination resulting from product transfer may give rise to light hydrocarbon vapour in the headspace of tanks that have previously contained gasoline. This vapour may explode if there is a source of ignition. Partly filled containers present a greater hazard than those that are full, therefore handling, transfer and sampling activities need special care. Even with proper grounding and bonding, this material can still accumulate an electrostatic charge. If sufficient charge is allowed to accumulate, electrostatic discharge and ignition of flammable air-vapour mixtures can occur. Be aware of handling operations that may give rise to additional hazards that result from the accumulation of static charges. These include but are not limited to pumping (especially turbulent flow), mixing, filtering, splash filling, cleaning and filling of tanks and containers, sampling, switch loading, gauging, vacuum truck operations, and mechanical movements. These activities may lead to static discharge e.g. spark formation. Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (<= 1 m/s until fill pipe submerged to twice its diameter, then <= 7 m/s). Avoid splash filling. Do NOT use compressed air for filling, discharging, or handling operations.

Recommended Materials : For containers, or container linings use mild steel, stainless steel. Aluminium may also be used for applications where it does not present an unnecessary fire hazard. Examples of suitable materials are: high density polyethylene (HDPE) and Viton (FKM), which have been specifically tested for compatibility with this product. For container linings, use

amine-adduct cured epoxy paint. For seals and gaskets use: graphite, PTFE, Viton A, Viton B.

Unsuitable Materials : Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Examples of materials to avoid are: natural rubber (NR), nitrile rubber (NBR), ethylene propylene rubber (EPDM), polymethyl methacrylate (PMMA), polystyrene, polyvinyl chloride (PVC), polyisobutylene. However, some may be suitable for glove materials.

Container Advice : Containers, even those that have been emptied, can contain explosive vapours. Do not cut, drill, grind, weld or perform similar operations on or near containers.

Other Advice : Ensure that all local regulations regarding handling and storage facilities are followed. See additional references that provide safe handling practices for liquids that are determined to be static accumulators: American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practices on Static Electricity). CENELEC CLC/TR 50404 (Electrostatics – Code of practice for the avoidance of hazards due to static electricity).

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

If the American Conference of Governmental Industrial Hygienists (ACGIH) value is provided on this document, it is provided for information only.

Occupational Exposure Limits

Material	Source	Type	ppm	mg/m3	Notation
Naphthalene	ACGIH	TWA	10 ppm		
	ACGIH	STEL	15 ppm		
	ACGIH	SKIN_DES			Can be absorbed through the skin.
	SG OEL	TWA	10 ppm	52 mg/m3	
	SG OEL	STEL	15 ppm	79 mg/m3	

Fuels, diesel	ACGIH	SKIN_DES(Inhalable fraction and vapor.)			Can be absorbed through the skin.as total hydrocarbons
	ACGIH	TWA(Inhalable fraction and vapor.)		100 mg/m3	as total hydrocarbons
Cumene	ACGIH	TWA	50 ppm		
	SG OEL	TWA	50 ppm	246 mg/m3	

Additional Information : Skin notation means that significant exposure can also occur by absorption of liquid through the skin and of vapour through the eyes or mucous membranes.

Biological Exposure Index (BEI)

Material	Determinant	Sampling Time	BEI	Reference
Naphthalene	1-Naphthol, with hydrolysis + 2-Naphthol, with hydrolysis	Sampling time: End of shift.		ACGIH BEL (02 2013)

Appropriate Engineering Controls : The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Use sealed systems as far as possible. Adequate explosion-proof ventilation to control airborne concentrations below the exposure guidelines/limits. Local exhaust ventilation is recommended. Eye washes and showers for emergency use. Always observe good personal hygiene measures, such as washing hands after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping. Define procedures for safe handling and maintenance of controls.

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		Educate and train workers in the hazards and control measures relevant to normal activities associated with this product. Ensure appropriate selection, testing and maintenance of equipment used to control exposure, e.g. personal protective equipment, local exhaust ventilation. Firewater monitors and deluge systems are recommended. Drain down system prior to equipment break-in or maintenance. Retain drain downs in sealed storage pending disposal or for subsequent recycle.
Individual Protection Measures	:	Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.
Respiratory Protection	:	If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Where air-filtering respirators are unsuitable (e.g. airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus. All respiratory protection equipment and use must be in accordance with local regulations. Select a filter suitable for combined particulate/organic gases and vapours [boiling point >65°C(149 °F)].
Hand Protection	:	Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. For continuous contact we recommend gloves with breakthrough time of more than 240 minutes with preference for > 480 minutes where suitable gloves can be identified. For short-term/splash protection we recommend the same, but recognise that suitable gloves offering this level of protection may not be available and in this case a lower breakthrough time may be acceptable so long as appropriate maintenance and replacement regimes are followed. Glove thickness is not a good predictor of glove resistance to a chemical as it is dependent on the exact composition of the glove material. Select gloves tested to a relevant standard (e.g. Europe EN374, US F739). When prolonged or frequent repeated contact occurs, Nitrile gloves may be suitable. (Breakthrough

		time of > 240 minutes.) For incidental contact/splash protection Neoprene, PVC gloves may be suitable.
Eye Protection	:	Chemical splash goggles (chemical monogoggles). If a local risk assessment deems it so, then chemical splash goggles may not be required and safety glasses may provide adequate eye protection.
Protective Clothing	:	Chemical resistant gloves/gauntlets, boots, and apron (where risk of splashing).
Thermal Hazards	:	Not applicable.
Monitoring Methods	:	Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate. Validated exposure measurement methods should be applied by a competent person and samples analysed by an accredited laboratory. Examples of sources of recommended exposure measurement methods are given below or contact the supplier. Further national methods may be available. National Institute of Occupational Safety and Health (NIOSH), USA: Manual of Analytical Methods http://www.cdc.gov/niosh/ Occupational Safety and Health Administration (OSHA), USA: Sampling and Analytical Methods http://www.osha.gov/
Environmental Exposure Controls	:	Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour. Information on accidental release measures are to be found in section 6. Take appropriate measures to fulfil the requirements of relevant environmental protection legislation. Avoid contamination of the environment by following advice given in Chapter 6. If necessary, prevent undissolved material from being discharged to waste water. Waste water should be treated in a municipal or industrial waste water treatment plant before discharge to surface water.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Colourless to yellowish. Liquid.
Odour	:	May contain a reodorant
Odour threshold	:	Data not available
pH	:	Not applicable
Initial Boiling Point and Boiling Range	:	170 - 390 °C / 338 - 734 °F
Pour point	:	<= 6 °C / 43 °F
Flash point	:	> 55 °C / 131 °F
Upper / lower Flammability or	:	1 - 6 %(V)

Explosion limits		
Auto-ignition temperature	:	> 220 °C / 428 °F
Vapour pressure	:	1 hPa at 20 °C / 68 °F
Relative Density	:	Data not available
Density	:	0.8 - 0.89 g/cm3 at 15 °C / 59 °F
Water solubility	:	Data not available
Solubility in other solvents	:	Data not available
n-octanol/water partition coefficient (log Pow)	:	3 - 6
Dynamic viscosity	:	Data not available
Kinematic viscosity	:	1.5 - 6 mm2/s at 40 °C / 104 °F
Vapour density (air=1)	:	Data not available
Electrical conductivity	:	Low conductivity: < 100 pS/m, The conductivity of this material makes it a static accumulator., A liquid is typically considered nonconductive if its conductivity is below 100 pS/m and is considered semi-conductive if its conductivity is below 10 000 pS/m., Whether a liquid is nonconductive or semi-conductive, the precautions are the same., A number of factors, for example liquid temperature, presence of contaminants, and anti-static additives can greatly influence the conductivity of a liquid.
Evaporation rate (nBuAc=1)	:	Data not available
Decomposition Temperature	:	Data not available
Flammability	:	Not applicable.

10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal use conditions.
Possibility of Hazardous Reactions	:	No hazardous reaction is expected when handled and stored according to provisions.
Conditions to Avoid	:	Avoid heat, sparks, open flames and other ignition sources.
Incompatible Materials	:	Strong oxidising agents.
Hazardous Decomposition Products	:	Hazardous decomposition products are not expected to form during normal storage. Thermal decomposition is highly dependent on conditions. A complex mixture of airborne solids, liquids and gases, including carbon monoxide, carbon dioxide and other organic compounds will be evolved when this material undergoes combustion or thermal or oxidative degradation.
Sensitivity to Static Discharge	:	Yes, in certain circumstances product can ignite due to static electricity.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological effects

Basis for Assessment	:	Information given is based on product data, a knowledge of the components and the toxicology of similar products. Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).
Likely Routes of Exposure	:	Exposure may occur via inhalation, ingestion, skin absorption, skin or eye contact, and accidental ingestion.
Acute Oral Toxicity	:	Low toxicity: LD50 > 5000 mg/kg , Rat
Acute Dermal Toxicity	:	Low toxicity: LD50 >2000 mg/kg , Rabbit
Acute Inhalation Toxicity	:	Harmful if inhaled. LC50 > 1.0 - <= 5.0 mg/l , 4 h, Rat High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued inhalation may result in unconsciousness and/or death.
Skin corrosion/irritation	:	Irritating to skin.
Serious eye damage/irritation	:	Expected to be slightly irritating.
Respiratory Irritation	:	Inhalation of vapours or mists may cause irritation to the respiratory system.
Respiratory or skin sensitisation	:	Not expected to be a sensitiser.
Aspiration Hazard	:	Aspiration into the lungs when swallowed or vomited may cause chemical pneumonitis which can be fatal.
Germ cell mutagenicity	:	Positive in in-vitro, but negative in in-vivo mutagenicity assays.
Carcinogenicity	:	Limited evidence of carcinogenic effect. Repeated skin contact has resulted in irritation and skin cancer in animals.

Material	:	**Carcinogenicity Classification**
Naphthalene	:	ACGIH Group A4: Not classifiable as a human carcinogen.
Naphthalene	:	NTP: Reasonably Anticipated to be a Human Carcinogen.
Naphthalene	:	IARC 2B: Possibly carcinogenic to humans.
Naphthalene	:	GHS / CLP: Carcinogenicity Category 2

Fuels, diesel	:	ACGIH Group A3: Confirmed animal carcinogen with unknown relevance to humans.
Fuels, diesel	:	GHS / CLP: Carcinogenicity Category 2
Distillates (Fischer-Tropsch) C8-26 - Branched and Linear	:	GHS / CLP: No carcinogenicity classification
Kerosine (Fischer Tropsch), Full range, C8-C16 branched and linear alkanes	:	GHS / CLP: No carcinogenicity classification
Cumene	:	IARC 2B: Possibly carcinogenic to humans.
Cumene	:	GHS / CLP: No carcinogenicity classification

Reproductive and Developmental Toxicity : Not expected to impair fertility. Not expected to be a developmental toxicant.

Specific target organ toxicity - single exposure : Not classified.

Specific target organ toxicity - repeated exposure : May cause damage to organs or organ systems through prolonged or repeated exposure. Blood. Thymus. Liver.

Additional Information : Classifications by other authorities under varying regulatory frameworks may exist.

12. ECOLOGICAL INFORMATION

Basis for Assessment : Information given is based on a knowledge of the components and the ecotoxicology of similar products. Fuels are typically made from blending several refinery streams. Ecotoxicological studies have been carried out on a variety of hydrocarbon blends and streams but not those containing additives. Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).

Acute Toxicity : Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l (to aquatic organisms) LL/EL50 expressed as the nominal amount of product required to prepare aqueous test extract.

Fish : Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l

Aquatic crustacea : Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l

Algae/aquatic plants : Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l

Microorganisms : Expected to be practically non toxic: LL/EL/IL50 > 100 mg/l

Chronic Toxicity

Fish : NOEC/NOEL expected to be > 0.01 - <= 0.1 mg/l (based on

		modeled data)
Aquatic crustacea	:	NOEC/NOEL expected to be > 0.1 - <= 1.0 mg/l (based on modeled data)
Mobility	:	Partly evaporates from water or soil surfaces, but a significant proportion will remain after one day. If product enters soil, one or more constituents will be mobile and may contaminate groundwater. Large volumes may penetrate soil and could contaminate groundwater. Floats on water.
Persistence/degradability	:	Major constituents are inherently biodegradable. The volatile constituents will oxidize rapidly by photochemical reactions in air.
Bioaccumulative Potential	:	Contains constituents with the potential to bioaccumulate. Log Kow > =4
Other Adverse Effects	:	Films formed on water may affect oxygen transfer and damage organisms.

13. DISPOSAL CONSIDERATIONS

Material Disposal	:	Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Do not dispose into the environment, in drains or in water courses. Do not dispose of tank water bottoms by allowing them to drain into the ground. This will result in soil and groundwater contamination. Waste arising from a spillage or tank cleaning should be disposed of in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand.
Container Disposal	:	Send to drum recoverer or metal reclaimer. Drain container thoroughly. After draining, vent in a safe place away from sparks and fire. Residues may cause an explosion hazard if heated above the flash point. Do not puncture, cut or weld uncleaned drums. Do not pollute the soil, water or environment with the waste container. Comply with any local recovery or waste disposal regulations.
Local Legislation	:	Disposal should be in accordance with applicable regional, national, and local laws and regulations. Local regulations may be more stringent than regional or national requirements and must be in compliance.

14. TRANSPORT INFORMATION

Land (as per ADR classification): Regulated

Class	:	3
Packing group	:	III
Hazard indentification no.	:	30
UN number	:	1202
Danger label (primary risk)	:	3
Proper shipping name	:	DIESEL FUEL
Environmentally Hazardous	:	Yes

IMDG

Identification number	UN 1202
Proper shipping name	DIESEL FUEL
Class / Division	3
Packing group	III
Environmental hazards:	Yes

IATA (Country variations may apply)

UN number	:	1202
Proper shipping name	:	Diesel fuel
Class / Division	:	3
Packing group	:	III

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Pollution Category	:	Not applicable.
Ship Type	:	Not applicable.
Product Name	:	Not applicable.
Special Precaution	:	Not applicable.
Additional Information	:	MARPOL Annex 1 rules apply for bulk shipments by sea.

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

Local Regulations

Workplace Safety and Health Act & Workplace Safety and Health (General Provision) Regulations	:	This product is subject to the requirement in the Act/ Regulations.
Environmental Protection and Management Act and Environmental Protection and Management	:	This product is subject to the requirement in the Act/ Regulations.

(Hazardous Substances) Regulations		
Maritime and Port Authority of Singapore (Dangerous Goods, Petroleum and Explosives) Regulations	:	This product is subject to the requirement in the Act/ Regulations.
Fire Safety Act and Fire Safety (Petroleum & Flammable Materials) Regulations	:	This product is subject to the requirement in the Act/ Regulations.
Classification triggering components	:	Contains fuels, diesel.
Other Information	:	IARC has classified diesel exhaust emissions as a Class 1 carcinogen - carcinogenic to humans. Steps should be taken to prevent personal exposure to diesel exhaust emissions.

16. OTHER INFORMATION

Hazard Statement

H226	Flammable liquid and vapour.
H227	Combustible liquid.
H304	May be fatal if swallowed and enters airways.
H315	Causes skin irritation.
H332	Harmful if inhaled.
H351	Suspected of causing cancer.
H373	May cause damage to organs or organ systems through prolonged or repeated exposure.
H401	Toxic to aquatic life.
H411	Toxic to aquatic life with long lasting effects.

Additional Information	:	This document contains important information to ensure the safe storage, handling and use of this product. The information in this document should be brought to the attention of the person in your organisation responsible for advising on safety matters.
SDS Version Number	:	1.1
SDS Effective Date	:	10.03.2014
SDS Revisions	:	A vertical bar (|) in the left margin indicates an amendment from the previous version.
Uses and Restrictions	:	This product must not be used in applications other than those recommended in Section 1, without first seeking the advice of the supplier. This product is not to be used as a solvent or cleaning agent;

Safety Data Sheet

for lighting or brightening fires; as a skin cleanser.

SDS Distribution : The information in this document should be made available to all who may handle the product.

Key/Legend to Abbrevations used in this SDS : The standard abbreviations and acronyms used in this document can be looked up in reference literature (e.g. scientific dictionaries) and/or websites.

Flam. Liq.	Flammable liquids
Asp. Tox.	Aspiration hazard
Acute Tox.	Acute toxicity
Skin Corr.	Skin corrosion/irritation
Carc.	Carcinogenicity
STOT RE	Specific target organ toxicity - repeated exposure

Key Literature References : The quoted data are from, but not limited to, one or more sources of information (e.g. toxicological data from Shell Health Services, material suppliers' data, CONCAWE, EU IUCLID date base, EC 1272 regulation, etc).

Disclaimer : This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

RESTEK CORP -- DIESEL RANGE ORGANICS STANDARD, 31064-5XX -- 6630-00N082737

========== Product Identification ==========

Product ID:DIESEL RANGE ORGANICS STANDARD, 31064-5XX
MSDS Date:09/28/1995
FSC:6630
NIIN:00N082737
MSDS Number: CGDMQ
=== Responsible Party ===
Company Name:RESTEK CORP
Address:110 BENNER CIRCLE
City:BELLEFONTE
State:PA
ZIP:16823-8812
Country:US
Info Phone Num:814-353-1300
Emergency Phone Num:814-353-1300
CAGE:0JL17
=== Contractor Identification ===
Company Name:RESTEK CORP
Address:110 BENNER CIR
Box:City:BELLEFONTE
State:PA
ZIP:16823-8812
Country:US
Phone:814-353-1300
CAGE:0JL17

========== Composition/Information on Ingredients ==========

Ingred Name:METHANE, DICHLORO-; (METHYLENE CHLORIDE) (SARA 313)
(CERCLA)
CAS:75-09-2
RTECS #:PA8050000
Fraction by Wt: 98.0%
OSHA PEL:500 PPM
ACGIH TLV:50 PPM, A2
EPA Rpt Qty:1000 LBS
DOT Rpt Qty:1000 LBS

Ingred Name:DECANE
CAS:124-18-5

RTECS #:HD6550000
Fraction by Wt: 0.2%
OSHA PEL:N/K
ACGIH TLV:N/K

Ingred Name:DODECANE
CAS:112-40-3
RTECS #:JR2125000
Fraction by Wt: 0.2%
OSHA PEL:N/K
ACGIH TLV:N/K

Ingred Name:TETRADECANE
CAS:629-59-4
RTECS #:XB8000000
Fraction by Wt: 0.2%
OSHA PEL:N/K
ACGIH TLV:N/K

Ingred Name:HEXADECANE
CAS:544-76-3
RTECS #:ML9200000
Fraction by Wt: 0.2%
OSHA PEL:N/K
ACGIH TLV:N/K

Ingred Name:OCTADECANE
CAS:593-45-3
Fraction by Wt: 0.2%
OSHA PEL:N/K
ACGIH TLV:N/K

Ingred Name:DICOSANE
CAS:112-95-8
Fraction by Wt: 0.2%
OSHA PEL:N/K
ACGIH TLV:N/K

Ingred Name:DOCOSANE
CAS:629-97-0
Fraction by Wt: 0.2%
OSHA PEL:N/K
ACGIH TLV:N/K

Ingred Name:TETRACOSANE
CAS:646-31-1
Fraction by Wt: 0.2%
OSHA PEL:N/K
ACGIH TLV:N/K

Ingred Name:HEXACOSANE
CAS:630-01-3
Fraction by Wt: 0.2%
OSHA PEL:N/K
ACGIH TLV:N/K

Ingred Name:OCTACOSANE
CAS:630-02-4
Fraction by Wt: 0.2%
OSHA PEL:N/K
ACGIH TLV:N/K

========== Hazards Identification ==========

LD50 LC50 Mixture:NONE SPECIFIED BY MANUFACTURER.
Routes of Entry: Inhalation:YES Skin:YES Ingestion:YES
Reports of Carcinogenicity:NTP:YES IARC:YES OSHA:NO
Health Hazards Acute and Chronic:ACUTE: INHAL: CAN CAUSE LT-HEAD, VERTIGO, DROW, NARCOSIS, HDCH & DIZZ, UNCON, & EVEN DEATH IN EXTREME CASES. EXPOS TO VAPS CAN ELEVATE CARBOXYHEMOGLOBIN LEVEL IN CARDIOVASCULAR SYS. EYES: LIQ/HIGH VAP CONC CAN CAUSE PAIN & IRRIT W/SLIGHT CORNEAL INJURY POSS. SKIN: PRLNG/RPTD CONT CAN CAUSE IRRIT & (EFTS OF OVEREXP)
Explanation of Carcinogenicity:METHYLENE CHLORIDE: IARC MONO, SUPP, VOL 7, PG 194, 1987: GROUP 2B. NTP 7TH ANNUAL REPORT ON CARCINS, 1994: (SUP DAT)
Effects of Overexposure:HLTH HAZ: DERM THRU DEFAT OF SKIN. PRLNG CONT CAN RSLT IN SKIN ABSORPTION. INGEST: CAN CAUSE BURNING OF THROAT & MOUTH. CHLOROCARBON MATLS HAVE PRDCED SENSIT OF MYOCARDIUM TO EPINEPHRINE IN LAB ANIMAL S & COULD HAVE SIMILAR EFT IN HUMANS. ADRENOMIMETICS (E.G., EPINEPHRINE) MAY BE CONTRAINDICATED EXCEPT FOR (SUP DAT)
Medical Cond Aggravated by Exposure:LIVER, KIDNEY, AND HEART CONDITIONS.

========== First Aid Measures ==========

First Aid:EYES: REMOVE CONT LENSES IF PRESENT. HOLD EYELIDS OPEN & IRRIGATE W/LGE VOLS OF WATER FOR AT LEAST 15 MIN. SEEK MED ASSIST. SKIN: IMMED WASH W/SOAP & WATER. CONTINUE RINSING W/LGE VOLS OF WATER FOR 15 MIN. REMOVE CONTAM CLTHG. SEEK MED TREATMENT. INHAL: REMOVE TO FRESH AIR. HAVE TRAINED PERS ADMIN OXYGEN & CPR IF NEEDED. CONT MD IMMED. INGEST: CONT POIS CTL CTR FOR ASSIST. NEVER GIVE (SUP DAT)

========== Fire Fighting Measures ==========

Flash Point Method:CC
Flash Point:NONE
Lower Limits:12%
Upper Limits:19%
Extinguishing Media:DRY CHEMICAL, CARBON DIOXIDE, FOAM, WATER SPRAY AS APPROPRIATE FOR SURROUNDING FIRE AND MATERIALS.
Fire Fighting Procedures:WEAR NIOSH APPROVED PRESSURE DEMAND SCBA AND FULL PROTECTIVE EQUIPMENT . KEEP FIRE-EXPOSED CONTAINERS COOL WITH WATER SPRAY.
Unusual Fire/Explosion Hazard:HEAT WILL BUILD PRESSURE AND MAY RUPTURE CLOSED STORAGE CONTAINERS. THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE HCL AND PHOSGENE .

========== Accidental Release Measures ==========

Spill Release Procedures:WEAR PERSONAL PROTECTIVE EQUIPMENT. ABSORB SMALL SPILLS ON PAPER, VERMICULITE, OR OTHER ABSORBENT. COLLECT AND STORE IN CLOSED CONTAINER FOR DISPOSAL.
Neutralizing Agent:NONE SPECIFIED BY MANUFACTURER.

========== Handling and Storage ==========

Handling and Storage Precautions:AVOID ALL INHAL/CONT. KEEP IN TIGHTLY CLSD CONTR AT ALL TIMES. PROTECT FROM MOISTURE, TEMP EXTREMES & DIRECT SUNLIGHT. STORE IN COOL, WELL-VENTD AREA.
Other Precautions:HANDLE W/UTMOST CARE. STORE IN EXPLOSION-PROOF REFRIGERATOR AT 4C. NO SMOKING IN AREA OF USE. DO NOT USE IN GENERAL VICINITY OF ARC WELDING, OPEN FLAMES/HOT SURFACES. HEAT &/OR UV RADIATION MAY CAUSE FORM OF HCL &/OR PHOSGENE .

========== Exposure Controls/Personal Protection ==========

Respiratory Protection:FOLLOW NIOSH AND EQUIPMENT MANUFACTURE RECOMMENDATIONS TO DETERMINE APPROPRIATE RESPIRATOR.
Ventilation:USE IN AN AREA PROVIDED WITH GENERAL AND LOCAL EXHAUST VENTILATION MEETING OSHA REQUIREMENTS.
Protective Gloves:VITON, POLYVINYL ALCOHOL, OR NEOPRENE.
Eye Protection:ANSI APPRVD CHEM WORKERS GOGGLES .
Other Protective Equipment:ANSI APPROVED EMERGENCY EYEWASH AND DELUGE SHOWER . PROTECTIVE CLOTHING MEETING LABORATORY SAFETY PRECAUTIONS.
Work Hygienic Practices:NONE SPECIFIED BY MANUFACTURER.
Supplemental Safety and Health
EFTS OF OVEREXP: LIFE-SUSTAINING USES IN HUMANS ACUTELY/CHRONICALLY EXPOSED TO CHLOROCARBONS . EXPLAN OF CARCIN: ANTIC TO BE CARCIN. ANIMAL: LUNG. FIRST AID PROC: ANYTHING BY MOUTH TO VICTIM THA T IS UNCON/HAVING CONVLS. CONT MD IMMED.

========== Physical/Chemical Properties ==========

Boiling Pt:B.P. Text:104F,40C
Vapor Pres:350 @ 20C
Spec Gravity:1.33
Solubility in Water:1.6% BY WEIGHT @ 20C
Appearance and Odor:COLORLESS; ETHER-LIKE ODOR

========== Stability and Reactivity Data ==========

Stability Indicator/Materials to Avoid:YES
ACTIVE METALS AND STRONG ALKALINE SOLUTIONS.
Stability Condition to Avoid:HEAT, SPARKS, OPEN FLAMES, MOISTURE.
Hazardous Decomposition Products:TOXIC AND CORROSIVE GASES ARE FORMED ON CONTACT WITH FLAMES OR HOT SURFACES. HCL, PHOSGENE .

========== Disposal Considerations ==========

Waste Disposal Methods:INCINERATE AT AN APPROVED FACILITY IN ACCORDANCE WITH FEDERAL, STATE, AND LOCAL REGULATIONS.

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particular situation.

APG

Analytical Products Group, Inc.

2730 Washington Blvd., Belpre, OH 45714
740-423-4200 800-272-4442 Fax 740-423-5588

Material Safety Data Sheet

Date prepared on: 9/18/95

Last revised on: 1/20/08

Page **1**

Section I: Product Identification

CATALOG NUMBER: 2700,4250,4252,4253,9180,9680, 4840, 4842, 224840	PRODUCT NAME: Gasoline Range Organics (GRO)

Section II - Hazardous Ingredients/Identity Information

Chemical Name	CAS Reg. No.	OSHA PEL (TWA)	% Composition*
Methanol	67-56-1	200ppm	>99.5%
Total concentration of unleaded gasoline compounds in the standard is less than 0.5%			

Section III - Physical/Chemical Characteristics of Hazardous Ingredients

Methanol

BOILING POINT: 65 C (149 F)	SPECIFIC GRAVITY: 0.7914	
VAPOR PRESSURE: 97 mmHg @ 20 C	SOLUBILITY IN WATER: Very soluble	APPEARANCE/ODOR: Clear, colorless liquid with a pungent odor (methanol).

Section IV - Fire and Explosion Hazard Data

FLASH POINT (Method used): 11 C (52 F) Closed Cup	AUTO IGNITION TEMPERATURE: 385 C (725 F)	FLAMMABLE LIMITS	LEL 6%	UEL 36%
EXTINGUISHING MEDIA: Use extinguisher media appropriate for surrounding fire since sample size is small. Alcohol foam, dry chemical or carbon dioxide (water may be ineffective in most laboratory situations).				
SPECIAL FIRE FIGHTING PROCEDURES: Firefighters should wear proper protective equipment and self contained breathing apparatus with full face piece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire exposed containers cool.				
UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode. Contact with strong oxidizers may cause fire. Burns with a clear almost invisible flame.				

Section V - Reactivity Data

STABILITY:	Unstable ☐	Stable ☒	Conditions to Avoid: Heat, flame and other sources of ignition.
INCOMPATIBILITY (Materials to avoid): Strong oxidizing agents, strong acids, zinc, aluminum and magnesium.			
HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide, carbon dioxide and formaldehyde.			
HAZARDOUS POLYMERIZATION:	May Occur ☐	Will Not Occur ☒	Conditions to Avoid: None Known

Section VI - Health Hazard Data

ROUTES OF ENTRY	Inhalation? YES	Skin? YES	Ingestion? YES
HEALTH HAZARDS (Acute and Chronic): ACUTE: Yes, see chronic symptoms. CHRONIC: Methanol is a poison by ingestion. Methanol ingestion may be fatal or cause blindness, headache, nausea, vomiting, dizziness, gastrointestinal irritation, central nervous system depression and hearing loss.			
COMPONENTS LISTED AS CARCINOGENS OR POTENTIAL CARCINOGENS: Gasoline is a suspected carcinogen.			
SIGNS AND SYMPTOMS OF EXPOSURE: Irritation of skin, eyes, nose , throat and headache. Prolonged contact may cause dermatitis. Exposure effects may differ between individuals.			
MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: Eye disorders, skin disorders, liver and kidney damage.			

EMERGENCY AND FIRST AID PROCEDURES: Seek medical assistance for treatment, observation and support if necessary. EYE CONTACT: Flush with water, obtain medical attention. SKIN CONTACT: Wash with soap and water, use protective creams. INHALATION: Remove to fresh air, if not breathing give artificial respiration. If breathing is difficult give oxygen and obtain medical attention. INGESTION: If conscious, give water and baking soda and induce vomiting. Obtain medical assistance immediately.

Section VII - Precautions for Safe Handling and Use

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: (Sample) shut of ignition sources. No flares, smoking or flames in area. Take up with sand or other non-combustible absorbent material and place into container for later disposal. Flush area with water.
WASTE DISPOSAL METHOD: Dispose in accordance with all applicable federal, state, and local environmental regulations. Excess sample should be placed in a proper waste solvent container.
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Keep container tightly closed, store in a cool, dry, well ventilated, flammable liquid storage area.
OTHER PRECAUTIONS* Do not heat or evaporate sample to dryness.

Section VIII - Control Measures

RESPIRATORY PROTECTION (Please specify): Required if airborne concentrations exceed TWA of 200 ppm.	
VENTILATION: Local exhaust (general or local exhausts to meet TLV regulations).	
PROTECTIVE GLOVES: Rubber gloves recommended.	EYE PROTECTION: Safety glasses or goggles.
OTHER PROTECTIVE EQUIPMENT: Impervious Clothing	
EMERGENCY WASH FACILITIES: Maintain eye wash and quick drench showers in work area.	

The information stated in this Material Safety Data Sheet (MSDS) is believed to be correct on the date of publication and must not be considered all conclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. Persons not specifically and properly trained should not handle this chemical or its container. This MSDS is provided without any warranty expressed or implied, including merchantability or fitness for any particular purpose.

This product is furnished for laboratory use ONLY! Our standards may not be used as drugs, cosmetics, agricultural or pesticidal products, food additives or as house hold chemicals.

* Various Government agencies (i.e., Department of Transportation, Occupational Safety and Health Administration, Environmental Protection Agency, and others) may have specific regulations concerning the transportation, handling, storage or use of this product which may not be contained herein. The customer or user of this product should be familiar with these regulations.

BP NORTH AMERICA PETROLEUM INC -- RESIDUAL FUEL OIL, BUNKER C, FUEL OIL NO.4/5/6 -- 9140-00-247-4354

========== Product Identification ==========

Product ID:RESIDUAL FUEL OIL, BUNKER C, FUEL OIL NO.4/5/6
MSDS Date:10/01/1993
FSC:9140
NIIN:00-247-4354
MSDS Number: BTVXJ
=== Responsible Party ===
Company Name:BP NORTH AMERICA PETROLEUM INC
Address:550 WESTLAKE PARK BLVD SUITE 1800
City:HOUSTON
State:TX
ZIP:77079-2608
Country:US
Info Phone Num:713-558-3443
Emergency Phone Num:713-558-3443
Preparer's Name:BP OIL HSEQ DEPT.
CAGE:0BF86
=== Contractor Identification ===
Company Name:AIR BP, BP OIL LTD
Address:CLEVELAND HOPKINS INTL AIRPORT
Box:City:CLEVELAND
State:OH
ZIP:44135
Country:US
Phone:216-267-3550
CAGE:0NDT1
Company Name:BP NORTH AMERICA PETROLEUM INC
Address:550 WESTLAKE PARK BLVD SUITE 1800
Box:City:HOUSTON
State:TX
ZIP:77079-2608
Country:US
Phone:713-558-3443
CAGE:0BF86
Company Name:BP OIL INTERNATIONAL LTD
Address:BRITANNIC HOUSE, MOOR LN
Box:City:LONDON ENGLAND
CAGE:7X331

========== Composition/Information on Ingredients ==========

Ingred Name:FUEL OIL #6
CAS:68553-00-4
Fraction by Wt: <100%
Other REC Limits:NONE RECOMMENDED

Ingred Name:HYDROGEN SULFIDE (SARA III)
CAS:7783-06-4
RTECS #:MX1225000
Fraction by Wt: TRACE
Other REC Limits:NONE RECOMMENDED
OSHA PEL:C, 20 PPM
ACGIH TLV:10 PPM/15 STEL; 9394
EPA Rpt Qty:100 LBS
DOT Rpt Qty:100 LBS

========== Hazards Identification ==========

Routes of Entry: Inhalation:YES Skin:NO Ingestion:NO
Reports of Carcinogenicity:NTP:NO IARC:YES OSHA:NO
Health Hazards Acute and Chronic:ACUTE: MAY BE IRRITATING TO SKIN, EYES AND RESPIRATORY TRACT. POSSIBLE ASPIRATION HAZARD IF SWALLOWED-CAN ENTER LUNGS AND CAUSE DAMAGE. INHALATION MAY CAUSE CNS EFFECTS. TOXIC HYDROGEN SULFIDE GAS MAY BE PRESENT IN CONFINED VAPOR SPACES. CHRONIC: SKIN CANCER HAZARD BASED ON TESTS WITH LABORATORY ANIMALS.
Explanation of Carcinogenicity:IARC HAS DETERMINED THAT DIESEL ENGINE EXHUST IS PORBABLY CARCINOGENIC TO HUMANS (IARC CLASS 2A).
Effects of Overexposure:INHALED: EUPHORIA, HEADACHE, DIZZINESS, DROWSINESS, BLURRED VISION, FATIGUE, TREMORS, CONVULSIONS, LOSS OF CONSCIOUSNESS, COMA, RESPIRATORY ARREST AND DEATH. SWALLOWED: NAUSEA, VOMITING, DIARRHEA. SKI N: REDNESS, ITCHING, INFLAMMATION, CRACKING, POSSIBLE SECONDARY INFECTION. EYES: REDNESS, TEARING, DISCOMFORT.
Medical Cond Aggravated by Exposure:NONE SPECIFIED BY MANUFACTURER.

========== First Aid Measures ==========

First Aid:INGESTION-DO NOT INDUCE VOMITING!IF SPONTANEOUS VOMITING OCCURS;MONITOR FOR BREATHING DIFFICULTY.GET IMMEDIATE MEDICAL ATTENTION.SKIN-REMOVE CONTAMINATED CLOTHES.WASH WITH SOAP & WATER.GET MEDICAL ATT ENTION IF IRRITATION PERSISTS.EYES-FLUSH WITH LOTS OF WATER FOR 15 MINUTES,HOLD LIDS OPEN.GET MEDICAL ATTENTION.INHALED-REMOVE TO FRESH AIR.RESTORE BREATHING.GET MEDICAL ATTENTION.

========== Fire Fighting Measures ==========

Flash Point:140F,60C
Extinguishing Media:WATER SPRAY, DRY CHEMICAL, FOAM OR CARBON DIOXIDE. USE WATER SPRAY TO COOL FIRE EXPOSED CONTAINERS.
Fire Fighting Procedures:WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL BUNKER GEAR. IF NOT IGNITED, VENTILATE AREA AND USE WATER SPRAY TO DISPERSE VAPOR OR PROTECT PERSONNEL.
Unusual Fire/Explosion Hazard:DANGEROUS WHEN EXPOSED TO HEAT OR FLAME. CONTAINERS MAY EXPLODE IN HEAT OF FIRE. RUNOFF TO SEWER MAY CAUSE FIRE OR EXPLOSION HAZARD.

========== Accidental Release Measures ==========

Spill Release Procedures:TAKE IMMEDIATE STEPS TO STOP AND CONTAIN THE SPILL. EXERCISE CAUTION-ENSURE PERSONNEL WEAR PROPER CLOTHING/EQUIPMENT. NOTIFY NATIONAL RESPONSE CENTER (800-424-8802), IF REQUIRED. ALSO NOTIFY LOCAL/STA TE REGULATORY AGENCIES, THE LEPC AND THE SERC.
Neutralizing Agent:NONE SPECIFIED BY MANUFACTURER.

========== Handling and Storage ==========

Handling and Storage Precautions:AVOID EXTREMES OF TEMPERATURE IN STORAGE. STORE IN TIGHTLY CLSED CONTAINERS IN A COOL, DRY, WELL-VETILATED AREA AWAY FROM HEAT SOURCES OF IGNITION.
Other Precautions:ALSO STORE AWAY FROM INCOMPATIBLE MATERIALS. GROUND LINES AND EQUIPMENT DURING TRANSFER TO REDUCE POSSIBILITY OF STATIC SPARK INITIATED FIRE OR EXPLOSION. USE NON-SPARKING TOOLS. DO NOT

STORE IN UNLAB ELED CONTAINERS.

========== Exposure Controls/Personal Protection ==========

Respiratory Protection:IF ENGINEERING CONTROLS FAIL OR NON-ROUTINE USE OR EMERGENCY OCCURS; USE NIOSH/MSHA APPROVED RESPIRATOR OR SUPPLIED AIR RESPIRATOR OR SCBA, AS REQUIRED. USE IAW 29 CFR 1910.134.
Ventilation:USE ADEQUATE EXPLOSION-PROOF MECHANICAL VENTILATION OR LOCAL EXHAUST TO MAINTAIN EXPOSURE BELOW PEL/TLV.
Protective Gloves:CHEMICAL RESISTANT-EG. NITRILE.
Eye Protection:SAFETY GLASSES/CHEMICAL SPLASH GOGGLES
Other Protective Equipment:DEPENDING ON CONDITIONS, ADDITIONAL EQUIPMENT SUCH AS FACE SHIELD, APRON, ARMCOVERS ETC. SHOULD BE WORN. EYEWASH STATION
Work Hygienic Practices:WASH HANDS AFTER USE AND BEFORE EATING, DRINKING, OR SMOKING. LAUNDER CONTAMINATED CLOTHES BEFORE REUSE.
Supplemental Safety and Health

========== Physical/Chemical Properties ==========

HCC:F4
Boiling Pt:B.P. Text:>399F,>204C
Melt/Freeze Pt:M.P/F.P Text:50.0F,10.0C
Vapor Pres:NEGLIGIBLE
Vapor Density:NEGLIGIBLE
Spec Gravity:0.95-1.01
Viscosity:10-55 CST
Evaporation Rate & Reference:<1 (WATER=1)
Solubility in Water:NEGLIGIBLE
Appearance and Odor:BLACK VISCOUS LIQUID; PETROLEUM OIL ODOR.

========== Stability and Reactivity Data ==========

Stability Indicator/Materials to Avoid:YES
STRONG OXIDIZING AGENTS.
Stability Condition to Avoid:AVOID CONTACT WITH STRONG OXIDIZING AGENTS.
Hazardous Decomposition Products:COMBUSTION MAY PRODUCE CARBON MONOXIDE & CARBON DIOXIDE & REACTIVE HYDROCARBONS.; MAY ALSO PRODUCE OXIDES OF SULFUR, H2S

========== Disposal Considerations ==========

Waste Disposal Methods:DISPOSE OF IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS. UNUSED/UNCONTAMINATED PRODUCT IS NOT AN EPA/RCRA WASTE; HOWEVER, IF MIXED WITH OTHER MATERIALS OR HAZARDOUS WASTE, THE PRODUCT MAY B ECOME REGULATED AS SUCH.

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Safety Data Sheet

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

Material Name	:	**Gasoline**
Other Names / Synonyms	:	MOGAS, ULG 95, 88 RON, 90 RON, 91 RON, 92 RON, 93 RON, 95 RON, 97 UNLD, 91 UNLD
Recommended Use / Restrictions of Use	:	Fuel for spark ignition engines designed to run on unleaded fuel.
Supplier	:	**Shell Eastern Trading (PTE) Ltd** 9 North Buona Vista Drive, #07-01, Tower 1, The Metropolis Singapore 138588 Singapore
Telephone	:	+65-6384 8000
Emergency Telephone Number	:	+44 (0) 151 350 4595

2. HAZARDS IDENTIFICATION

GHS Classification	:	Flammable liquids, Category 1 Skin corrosion/irritation, Category 2 Aspiration hazard, Category 1 Toxic to reproduction, Category 2 Germ cell mutagenicity, Category 1B Carcinogenicity, Category 1B Specific target organ toxicity - single exposure, Category 3, Inhalation, Narcotic effects. Acute hazards to the aquatic environment, Category 2 Hazardous to the aquatic environment - Long-term Hazard, Category 2
GHS Label Elements Symbol(s)	:	
Signal Words	:	Danger
Hazard Statement	:	PHYSICAL HAZARDS:

Safety Data Sheet

H224: Extremely flammable liquid and vapour.

HEALTH HAZARDS:
H304: May be fatal if swallowed and enters airways.
H315: Causes skin irritation.
H336: May cause drowsiness or dizziness.
H340: May cause genetic defects.
H350: May cause cancer.
H361: Suspected of damaging fertility or the unborn child.

ENVIRONMENTAL HAZARDS:
H401: Toxic to aquatic life.
H411: Toxic to aquatic life with long lasting effects.

GHS Precautionary Statements

Prevention : P201: Obtain special instructions before use.
P210: Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P280: Wear protective gloves/protective clothing/eye protection/face protection.

Response : P301+P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.

Storage : P403+P233: Store in a well-ventilated place. Keep container tightly closed.

Disposal: : P501: Dispose of contents and container to appropriate waste site or reclaimer in accordance with local and national regulations.

Other Hazards which do not result in classification : Liquid evaporates quickly and can ignite leading to a flash fire, or an explosion in a confined space. This material is a static accumulator. Even with proper grounding and bonding, this material can still accumulate an electrostatic charge. If sufficient charge is allowed to accumulate, electrostatic discharge and ignition of flammable air-vapour mixtures can occur.
Slightly irritating to respiratory system. This product contains benzene which may cause leukaemia (AML - acute myelogenous leukaemia). May cause MDS (Myelodysplastic Syndrome).

Additional Information : This product is intended for use in closed systems only.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Mixture Description : Complex mixture of hydrocarbons consisting of paraffins, cycloparaffins, aromatic and olefinic hydrocarbons with carbon numbers predominantly in the C4 to C12 range. Includes benzene at 0.1 - 5% v/v. Contains oxygenated hydrocarbons which may include methyl tertiary butyl ether (MTBE) and other ethers. May also contain several additives at <0.1% v/v each.

Synonyms : MOGAS, ULG 95, 88 RON, 90 RON, 91 RON, 92 RON, 93 RON, 95 RON, 97 UNLD, 91 UNLD

Classification of components according to GHS

Chemical Identity	Synonyms	CAS	Hazard Class (category)	Hazard Statement	Conc.
Gasoline, low boiling point naphtha	Gasoline, low boiling point naphtha	86290-81-5	Flam. Liq., 1; Skin Corr., 2; Asp. Tox., 1; Muta., 1B; Carc., 1B; STOT SE, 3; Aquatic Chronic, 2; Aquatic Acute, 2; Repr., 2;	H224; H315; H304; H340; H350; H336; H411; H401; H361;	85.00 - 100.00 %
Ethyl tertiary butyl ether	Ethyl tertiary butyl ether	637-92-3	Flam. Liq., 2; STOT SE, 3; Asp. Tox., 2; Aquatic Acute, 3;	H225; H336; H305; H402;	0.00 - 15.00 %
Methyl tertiary butyl ether	Methyl tertiary butyl ether	1634-04-4	Flam. Liq., 2; Skin Corr., 3; Acute Tox., 5; Asp. Tox., 2;	H225; H316; H303; H305;	0.00 - 15.00 %
Tertiary amyl methyl ether	Tertiary amyl methyl ether	994-05-8	Flam. Liq., 2; Acute Tox., 4; STOT SE, 3;	H225; H302; H336;	0.00 - 15.00 %

Additional Information : Contains Benzene, CAS # 71-43-2. Contains Toluene, CAS # 108-88-3. Contains Ethylbenzene, CAS # 100-41-4. Contains n-Hexane, CAS # 110-54-3. Contains Xylene (Mixed Isomers), CAS # 1330-20-7. Contains Cyclohexane, CAS# 110-82-7. Contains Cumene, CAS# 98-82-8 Contains Tri-methyl-benzene (all isomers), CAS# 25551-13-7.

Contains Naphthalene, CAS # 91-20-3.

The amount of oxygenated components is limited at 2.7 % m/m calculated as oxygen. Alcohols may be present at <0.1%v. Dyes and markers can be used to indicate tax status and prevent fraud. Refer to Ch 16 for full text of H phrases.

Refer to chapter 16 for full text of EC R-phrases.

4. FIRST-AID MEASURES

Inhalation	:	Remove to fresh air. If rapid recovery does not occur, transport to nearest medical facility for additional treatment.
Skin Contact	:	Remove contaminated clothing. Immediately flush skin with large amounts of water for at least 15 minutes, and follow by washing with soap and water if available. If redness, swelling, pain and/or blisters occur, transport to the nearest medical facility for additional treatment. When using high pressure equipment, injection of product under the skin can occur. If high pressure injuries occur, the casualty should be sent immediately to a hospital. Do not wait for symptoms to develop.
Eye Contact	:	Flush eyes with water while holding eyelids open. Rest eyes for 30 minutes. If redness, burning, blurred vision, or swelling persist transport to the nearest medical facility for additional treatment.
Ingestion	:	If swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment. If vomiting occurs spontaneously, keep head below hips to prevent aspiration. If any of the following delayed signs and symptoms appear within the next 6 hours, transport to the nearest medical facility: fever greater than 101° F (38.3°C), shortness of breath, chest congestion or continued coughing or wheezing.
Most Important Symptoms/Effects, Acute & Delayed	:	Skin irritation signs and symptoms may include a burning sensation, redness, or swelling. Eye irritation signs and symptoms may include a burning sensation and a temporary redness of the eye. If material enters lungs, signs and symptoms may include coughing, choking, wheezing, difficulty in breathing, chest congestion, shortness of breath, and/or fever. The onset of respiratory symptoms may be delayed for several hours after exposure. Breathing of high vapour concentrations may cause central nervous system (CNS) depression resulting in dizziness, light-headedness, headache, nausea and loss of coordination. Continued inhalation may result in unconsciousness and death. Auditory system effects may include temporary hearing loss and/or ringing in the ears.

Immediate medical attention, special treatment	:	Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

Specific hazards arising from Chemicals	:	Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Carbon monoxide may be evolved if incomplete combustion occurs. Unidentified organic and inorganic compounds. The vapour is heavier than air, spreads along the ground and distant ignition is possible. Will float and can be reignited on surface water.
Suitable Extinguishing Media	:	Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
Unsuitable Extinguishing Media	:	Do not use direct water jets on the burning product as they could cause a steam explosion and spread of the fire. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.
Protective Equipment & Precautions for Fire Fighters	:	Proper protective equipment including chemical resistant gloves are to be worn; chemical resistant suit is indicated if large contact with spilled product is expected. Self-Contained Breathing Apparatus must be worn when approaching a fire in a confined space. Select fire fighter's clothing approved to relevant Standards (e.g. Europe: EN469).
Additional Advice	:	Keep adjacent containers cool by spraying with water. If possible remove containers from the danger zone. If the fire cannot be extinguished the only course of action is to evacuate immediately. Contain residual material at affected sites to prevent material from entering drains (sewers), ditches, and waterways.

6. ACCIDENTAL RELEASE MEASURES

Avoid contact with skin, eyes and clothing. Evacuate the area of all non-essential personnel. Ventilate contaminated area thoroughly. If contamination of sites occurs remediation may require specialist advice. Avoid contact with spilled or released material. Immediately remove all contaminated clothing. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. For guidance on disposal of spilled material see Chapter 13 of this Material Safety Data Sheet. Ensure electrical continuity by bonding and grounding (earthing) all equipment. Observe the relevant local and international regulations. Take precautionary measures against static discharges.

Personal Precautions, Protective Equipment and Emergency Procedures	:	Do not breathe fumes, vapour. Do not operate electrical equipment. Shut off leaks, if possible without personal risks. Remove all possible sources of ignition in the surrounding area. Vapour can travel for considerable distances both above and below the ground surface. Underground services (drains, pipelines, cable ducts) can provide preferential flow paths. Evacuate all personnel. Attempt to disperse vapour or to direct its flow to a safe location for example using fog sprays.
Environmental Precautions	:	Take measures to minimise the effects on groundwater. Contain residual material at affected sites to prevent material from entering drains (sewers), ditches, and waterways. Prevent from spreading or entering into drains, ditches or rivers by using sand, earth, or other appropriate barriers.
Methods and Material for Containment and Cleaning Up	:	Take precautionary measures against static discharges. For large liquid spills (> 1 drum), transfer by mechanical means such as vacuum truck to a salvage tank for recovery or safe disposal. Do not flush away residues with water. Retain as contaminated waste. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely. For small liquid spills (< 1 drum), transfer by mechanical means to a labelled, sealable container for product recovery or safe disposal. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely.
Additional Advice	:	Notify authorities if any exposure to the general public or the environment occurs or is likely to occur. Local authorities should be advised if significant spillages cannot be contained. Maritime spillages should be dealt with using a Shipboard Oil Pollution Emergency Plan (SOPEP), as required by MARPOL Annex 1 Regulation 26. To the extent that this product, including its chemical components (e.g. methyl tertiary butyl ether) may impact surface or groundwater, appropriate assessment and remediation (if necessary) should be implemented.

7. HANDLING AND STORAGE

General Precautions	:	Avoid breathing vapours or contact with material. Only use in well ventilated areas. Wash thoroughly after handling. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for

		safe handling, storage and disposal of this material. Air-dry contaminated clothing in a well-ventilated area before laundering. Prevent spillages. Turn off all battery operated portable electronic devices (examples include: cellular phones, pagers and CD players) before operating gasoline pump. Contaminated leather articles including shoes cannot be decontaminated and should be destroyed to prevent reuse. Do not use as a cleaning solvent or other non-motor fuel uses. Vehicle fueling and vehicle workshop areas - Avoid inhalation of vapours and contact with skin, when filling or emptying a vehicle.
Precautions for Safe Handling	:	When using do not eat or drink. Extinguish any naked flames. Do not smoke. Remove ignition sources. Avoid sparks. Never siphon by mouth. The vapour is heavier than air, spreads along the ground and distant ignition is possible. Avoid exposure. Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires.
Conditions for Safe Storage	:	Drum and small container storage: Keep containers closed when not in use. Drums should be stacked to a maximum of 3 high. Use properly labelled and closeable containers. Packaged product must be kept tightly closed and stored in a diked (bunded) well-ventilated area, away from, ignition sources and other sources of heat. Take suitable precautions when opening sealed containers, as pressure can build up during storage. Tank storage: Tanks must be specifically designed for use with this product. Bulk storage tanks should be diked (bunded). Locate tanks away from heat and other sources of ignition. Cleaning, inspection and maintenance of storage tanks is a specialist operation, which requires the implementation of strict procedures and precautions. Keep in a cool place. Electrostatic charges will be generated during pumping. Electrostatic discharge may cause fire. Ensure electrical continuity by bonding and grounding (earthing) all equipment to reduce the risk. The vapours in the head space of the storage vessel may lie in the flammable/explosive range and hence may be flammable. Refer to section 15 for any additional specific legislation covering the packaging and storage of this product.
Product Transfer	:	Wait 2 minutes after tank filling (for tanks such as those on road tanker vehicles) before opening hatches or manholes. Wait 30 minutes after tank filling (for large storage tanks) before opening hatches or manholes. Even with proper grounding and bonding, this material can still accumulate an electrostatic charge. If sufficient charge is allowed to

		accumulate, electrostatic discharge and ignition of flammable air-vapour mixtures can occur. Be aware of handling operations that may give rise to additional hazards that result from the accumulation of static charges. These include but are not limited to pumping (especially turbulent flow), mixing, filtering, splash filling, cleaning and filling of tanks and containers, sampling, switch loading, gauging, vacuum truck operations, and mechanical movements. These activities may lead to static discharge e.g. spark formation. Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (<= 1 m/s until fill pipe submerged to twice its diameter, then <= 7 m/s). Avoid splash filling. Do NOT use compressed air for filling, discharging, or handling operations.
Recommended Materials	:	For containers, or container linings use mild steel, stainless steel. Aluminium may also be used for applications where it does not present an unnecessary fire hazard. Examples of suitable materials are: high density polyethylene (HDPE), polypropylene (PP), and Viton (FKM), which have been specifically tested for compatibility with this product. For container linings, use amine-adduct cured epoxy paint. For seals and gaskets use: graphite, PTFE, Viton A, Viton B.
Unsuitable Materials	:	Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Examples of materials to avoid are: natural rubber (NR), nitrile rubber (NBR), ethylene propylene rubber (EPDM), polymethyl methacrylate (PMMA), polystyrene, polyvinyl chloride (PVC), polyisobutylene. However, some may be suitable for glove materials.
Container Advice	:	Containers, even those that have been emptied, can contain explosive vapours. Do not cut, drill, grind, weld or perform similar operations on or near containers. Gasoline containers must not be used for storage of other products.
Other Advice	:	Ensure that all local regulations regarding handling and storage facilities are followed. See additional references that provide safe handling practices for liquids that are determined to be static accumulators: American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practices on Static Electricity). CENELEC CLC/TR 50404 (Electrostatics – Code of practice for the avoidance of hazards due to static electricity).

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

If the American Conference of Governmental Industrial Hygienists (ACGIH) value is provided on this document, it is provided for information only.

Occupational Exposure Limits

Material	Source	Type	ppm	mg/m3	Notation
Gasoline, low boiling point naphtha	ACGIH	TWA	300 ppm		
	ACGIH	STEL	500 ppm		
	SG OEL	TWA	300 ppm	890 mg/m3	
	SG OEL	STEL	500 ppm	1,480 mg/m3	
Trimethylbenzene, all isomers	ACGIH	TWA	25 ppm		
	SG OEL	TWA	25 ppm	123 mg/m3	
Ethylbenzene	ACGIH	TWA	20 ppm		
	SG OEL	TWA	100 ppm	434 mg/m3	
	SG OEL	STEL	125 ppm	543 mg/m3	
n-hexane	ACGIH	TWA	50 ppm		
	ACGIH	SKIN_DES			Can be absorbed through the skin.
	SG OEL	TWA	50 ppm	176 mg/m3	
Benzene	ACGIH	TWA	0.5 ppm		
	ACGIH	STEL	2.5 ppm		
	ACGIH	SKIN_DES			Can be absorbed through the skin.
	SG OEL	TWA	1 ppm	3.18 mg/m3	

	SHELL IS	TWA	0.5 ppm	1.6 mg/m3	
	SHELL IS	STEL	2.5 ppm	8 mg/m3	
Toluene	ACGIH	TWA	20 ppm		
	SG OEL	TWA	50 ppm	188 mg/m3	
Xylene	ACGIH	TWA	100 ppm		
	ACGIH	STEL	150 ppm		
	SG OEL	TWA	100 ppm	434 mg/m3	
	SG OEL	STEL	150 ppm	651 mg/m3	
Cyclohexane	ACGIH	TWA	100 ppm		
	SG OEL	TWA	300 ppm	1,030 mg/m3	
Naphthalene	ACGIH	TWA	10 ppm		
	ACGIH	STEL	15 ppm		
	ACGIH	SKIN_DES			Can be absorbed through the skin.
	SG OEL	TWA	10 ppm	52 mg/m3	
	SG OEL	STEL	15 ppm	79 mg/m3	
Ethyl tertiary butyl ether	ACGIH	TWA	25 ppm		
Methyl tertiary butyl ether	ACGIH	TWA	50 ppm		
	SG OEL	TWA	40 ppm	144 mg/m3	
Tertiary amyl methyl ether	ACGIH	TWA	20 ppm		
Cumene	ACGIH	TWA	50 ppm		
	SG OEL	TWA	50 ppm	246 mg/m3	

Additional Information : SHELL IS is the Shell Internal Standard. Skin notation means that significant exposure can also occur by absorption of liquid through the skin and of vapour through the eyes or mucous membranes.

Biological Exposure Index (BEI)

Material	Determinant	Sampling Time	BEI	Reference
Benzene	t,t-Muconic acid in Creatinine in urine	Sampling time: End of shift.	500 µg/g	ACGIH BEL (2011)
	S-Phenylmercapturic acid in Creatinine in urine	Sampling time: End of shift.	25 µg/g	ACGIH BEL (2011)
n-hexane	2,5-Hexanedion, without hydrolysis in Urine	Sampling time: End of shift at end of work week.	0.4 mg/l	ACGIH BEL (2011)
Toluene	o-Cresol, with hydrolysis in Creatinine in urine	Sampling time: End of shift.	0.3 mg/g	ACGIH BEL (2011)
	toluene in Blood	Sampling time: Prior to last shift of work week.	0.02 mg/l	ACGIH BEL (2011)
	toluene in Urine	Sampling time: End of shift.	0.03 mg/l	ACGIH BEL (2011)

Ethylbenzene	Sum of mandelic acid and phenylglyoxylic acid in Creatinine in urine	Sampling time: End of shift at end of work week.	0.7 g/g	ACGIH BEL (2011)
	Ethyl benzene in End-exhaled air	Sampling time: Not critical.		ACGIH BEL (2011)
Xylene	Methylhippuric acids in Creatinine in urine	Sampling time: End of shift.	1.5 g/g	ACGIH BEL (2011)
Naphthalene	1-Naphthol, with hydrolysis + 2-Naphthol, with hydrolysis	Sampling time: End of shift.		ACGIH BEL (02 2013)

Appropriate Engineering Controls : The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Use sealed systems as far as possible. Adequate explosion-proof ventilation to control airborne concentrations below the exposure guidelines/limits. Local exhaust ventilation is recommended. Eye washes and showers for emergency use. Always observe good personal hygiene measures, such as washing hands after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping. Define procedures for safe handling and maintenance of controls. Educate and train workers in the hazards and control measures relevant to normal activities associated with this product. Ensure appropriate selection, testing and maintenance of equipment used to control exposure, e.g. personal protective equipment, local exhaust ventilation. Firewater monitors and deluge systems are recommended. Drain down system prior to equipment break-in or maintenance. Retain drain downs in sealed storage pending disposal or for subsequent recycle.

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Individual Protection Measures	:	Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.
Respiratory Protection	:	If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Where air-filtering respirators are unsuitable (e.g. airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus. All respiratory protection equipment and use must be in accordance with local regulations. Select a filter suitable for combined particulate/organic gases and vapours [boiling point >65°C(149 °F)].
Hand Protection	:	Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. For continuous contact we recommend gloves with breakthrough time of more than 240 minutes with preference for > 480 minutes where suitable gloves can be identified. For short-term/splash protection we recommend the same, but recognise that suitable gloves offering this level of protection may not be available and in this case a lower breakthrough time may be acceptable so long as appropriate maintenance and replacement regimes are followed. Glove thickness is not a good predictor of glove resistance to a chemical as it is dependent on the exact composition of the glove material. Select gloves tested to a relevant standard (e.g. Europe EN374, US F739). When prolonged or frequent repeated contact occurs, Nitrile gloves may be suitable. (Breakthrough time of > 240 minutes.) For incidental contact/splash protection Neoprene, PVC gloves may be suitable.
Eye Protection	:	Chemical splash goggles (chemical monogoggles). If a local risk assessment deems it so, then chemical splash goggles may not be required and safety glasses may provide adequate eye protection.
Protective Clothing	:	Chemical resistant gloves/gauntlets, boots, and apron (where risk of splashing).
Thermal Hazards	:	Not applicable.

Monitoring Methods	:	Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate. Validated exposure measurement methods should be applied by a competent person and samples analysed by an accredited laboratory. Examples of sources of recommended exposure measurement methods are given below or contact the supplier. Further national methods may be available. National Institute of Occupational Safety and Health (NIOSH), USA: Manual of Analytical Methods http://www.cdc.gov/niosh/ Occupational Safety and Health Administration (OSHA), USA: Sampling and Analytical Methods http://www.osha.gov/
Environmental Exposure Controls	:	Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour. Take appropriate measures to fulfil the requirements of relevant environmental protection legislation. Avoid contamination of the environment by following advice given in Chapter 6. If necessary, prevent undissolved material from being discharged to waste water. Waste water should be treated in a municipal or industrial waste water treatment plant before discharge to surface water.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Yellow. Clear, bright liquid.
Odour	:	Hydrocarbon
Odour threshold	:	Data not available
pH	:	Data not available
Initial Boiling Point and Boiling Range	:	25 - 220 °C / 77 - 428 °F
Freezing Point	:	Data not available
Flash point	:	-40 °C / -40 °F (Tagliabue Closed Cup)
Upper / lower Flammability or Explosion limits	:	1 - 8 %(V)
Auto-ignition temperature	:	> 250 °C / 482 °F
Vapour pressure	:	Typical 570 hPa at 37.8 °C / 100.0 °F
Relative Density	:	Data not available
Density	:	Typical 0.740 g/cm3 at 15 °C / 59 °F
Water solubility	:	Negligible.
Solubility in other solvents	:	Data not available
n-octanol/water partition	:	2 - 7

coefficient (log Pow)		
Dynamic viscosity	:	Data not available
Kinematic viscosity	:	0.5 - 0.75 mm2/s at 40 °C / 104 °F
Vapour density (air=1)	:	Data not available
Electrical conductivity	:	Low conductivity: < 100 pS/m, The conductivity of this material makes it a static accumulator., A liquid is typically considered nonconductive if its conductivity is below 100 pS/m and is considered semi-conductive if its conductivity is below 10 000 pS/m., Whether a liquid is nonconductive or semi-conductive, the precautions are the same., A number of factors, for example liquid temperature, presence of contaminants, and anti-static additives can greatly influence the conductivity of a liquid.
Evaporation rate (nBuAc=1)	:	Data not available
Decomposition Temperature	:	Data not available
Flammability	:	Extremely flammable.

10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal conditions of use.
Possibility of Hazardous Reactions	:	No hazardous reaction is expected when handled and stored according to provisions.
Conditions to Avoid	:	Avoid heat, sparks, open flames and other ignition sources.
Incompatible Materials	:	Strong oxidising agents.
Hazardous Decomposition Products	:	Hazardous decomposition products are not expected to form during normal storage. Thermal decomposition is highly dependent on conditions. A complex mixture of airborne solids, liquids and gases, including carbon monoxide, carbon dioxide and other organic compounds will be evolved when this material undergoes combustion or thermal or oxidative degradation.
Hazardous Polymerisation	:	No
Sensitivity to Mechanical Impact	:	No
Sensitivity to Static Discharge	:	Yes, in certain circumstances product can ignite due to static electricity.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological effects

Basis for Assessment	:	Information given is based on product data, a knowledge of the components and the toxicology of similar products. Unless indicated otherwise, the data presented is representative of the

product as a whole, rather than for individual component(s).

Likely Routes of Exposure	:	Exposure may occur via inhalation, ingestion, skin absorption, skin or eye contact, and accidental ingestion.
Acute Oral Toxicity	:	Low toxicity: LD50 > 5000 mg/kg
Acute Dermal Toxicity	:	Low toxicity: LD50 >2000 mg/kg , Rabbit
Acute Inhalation Toxicity	:	Low toxicity: LC50 >5 mg/l , 4 h, Rat
Skin corrosion/irritation	:	Irritating to skin.
Serious eye damage/irritation	:	Expected to be slightly irritating.
Respiratory Irritation	:	Based on human experience, breathing of vapours or mists may cause a temporary burning sensation to nose, throat and lungs.
Respiratory or skin sensitisation	:	Not expected to be a sensitiser.
Aspiration Hazard	:	Aspiration into the lungs when swallowed or vomited may cause chemical pneumonitis which can be fatal.
Germ cell mutagenicity	:	May cause heritable genetic damage. (Benzene) Mutagenicity studies on gasoline and gasoline blending streams have shown predominantly negative results.
Carcinogenicity	:	Known human carcinogen. (Benzene) May cause leukaemia (AML - acute myelogenous leukemia). (Benzene) Inhalation exposure to mice causes liver tumours, which are not considered relevant to humans.

Material	:	**Carcinogenicity Classification**
Gasoline, low boiling point naphtha	:	ACGIH Group A3: Confirmed animal carcinogen with unknown relevance to humans.
Gasoline, low boiling point naphtha	:	IARC 2B: Possibly carcinogenic to humans.
Gasoline, low boiling point naphtha	:	GHS / CLP: Carcinogenicity Category 1B
Trimethylbenzene, all isomers	:	GHS / CLP: No carcinogenicity classification
Ethylbenzene	:	IARC 2B: Possibly carcinogenic to humans.
Ethylbenzene	:	GHS / CLP: No carcinogenicity classification
n-hexane	:	GHS / CLP: No carcinogenicity classification

Benzene	:	ACGIH Group A1: Confirmed human carcinogen.
Benzene	:	NTP: Known To Be Human Carcinogen.
Benzene	:	IARC 1: Carcinogenic to humans.
Benzene	:	GHS / CLP: Carcinogenicity Category 1A
Toluene	:	ACGIH Group A4: Not classifiable as a human carcinogen.
Toluene	:	IARC 3: Not classifiable as to carcinogenicity to humans.
Toluene	:	GHS / CLP: No carcinogenicity classification
Xylene	:	ACGIH Group A4: Not classifiable as a human carcinogen.
Xylene	:	IARC 3: Not classifiable as to carcinogenicity to humans.
Xylene	:	GHS / CLP: No carcinogenicity classification
Cyclohexane	:	GHS / CLP: No carcinogenicity classification
Naphthalene	:	ACGIH Group A4: Not classifiable as a human carcinogen.
Naphthalene	:	NTP: Reasonably Anticipated to be a Human Carcinogen.
Naphthalene	:	IARC 2B: Possibly carcinogenic to humans.
Naphthalene	:	GHS / CLP: Carcinogenicity Category 2
Ethyl tertiary butyl ether	:	ACGIH Group A4: Not classifiable as a human carcinogen.
Ethyl tertiary butyl ether	:	GHS / CLP: No carcinogenicity classification
Methyl tertiary butyl ether	:	IARC 3: Not classifiable as to carcinogenicity to humans.
Methyl tertiary butyl ether	:	GHS / CLP: No carcinogenicity classification
Tertiary amyl methyl ether	:	GHS / CLP: No carcinogenicity classification
Cumene	:	IARC 2B: Possibly carcinogenic to humans.
Cumene	:	GHS / CLP: No carcinogenicity classification

Reproductive and Developmental Toxicity : Causes foetotoxicity at doses which are maternally toxic. (Toluene)
May impair fertility at doses which produce other toxic effects. (n-hexane)
Many case studies involving abuse during pregnancy indicate that toluene can cause birth defects, growth retardation and learning difficulties. (Toluene)
Inhalation of high concentrations of gasoline vapour containing Methyl tertiary butyl ether produced a very low incidence of rare birth defects (ventral midline closure failure) in mice.

Specific target organ toxicity - single exposure : High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued inhalation may result in unconsciousness and/or death.

Specific target organ toxicity - repeated exposure : Kidney: caused kidney effects in male rats which are not considered relevant to humans

Blood-forming organs: repeated exposure affects the bone

marrow.

Additional Information : Prolonged and repeated exposures to high concentrations have resulted in hearing loss in rats. Solvent abuse and noise interaction in the work environment may cause hearing loss. (Toluene)

Abuse of vapours has been associated with organ damage and death. (Toluene)

Exposure to very high concentrations of similar materials has been associated with irregular heart rhythms and cardiac arrest.

May cause MDS (Myelodysplastic Syndrome). (Benzene)

Classifications by other authorities under varying regulatory frameworks may exist.

12. ECOLOGICAL INFORMATION

Basis for Assessment : Fuels are typically made from blending several refinery streams. Ecotoxicological studies have been carried out on a variety of hydrocarbon blends and streams but not those containing additives. Information given is based on a knowledge of the components and the ecotoxicology of similar products. Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).

Acute Toxicity : Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l (to aquatic organisms) LL/EL50 expressed as the nominal amount of product required to prepare aqueous test extract.

Fish : Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l

Aquatic crustacea : Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l

Algae/aquatic plants : Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l

Microorganisms : Expected to be harmful: LL/EL/IL50 >10 <= 100 mg/l

Chronic Toxicity

Fish : NOEC/NOEL expected to be > 1.0 - <= 10 mg/l

Aquatic crustacea : NOEC/NOEL expected to be > 1.0 - <= 10 mg/l

Mobility : Evaporates within a day from water or soil surfaces. Large volumes may penetrate soil and could contaminate groundwater. Toxic to aquatic organisms; may cause long-term adverse effects in the aquatic environment. Ether oxygenates are significantly more water soluble and less biodegradable

		than benzene, toluene, ethyl benzene and xylenes (BTEX). Consequently ether oxygenates have the potential to migrate relatively longer distances than BTEX in groundwater. Contains volatile components. Floats on water. Methyl tertiary butyl ether degradation may result in the formation of tert-butyl alcohol (TBA).
Persistence/degradability	:	Major constituents are expected to be inherently biodegradable, but the product contains components that may persist in the environment. The volatile constituents will oxidize rapidly by photochemical reactions in air. While biodegradation of Methyl tertiary butyl ether has been documented, it is generally less biodegradable than many petroleum hydrocarbons and has a potential to migrate relatively longer distances in groundwater.
Bioaccumulative Potential	:	Contains constituents with the potential to bioaccumulate. Log Kow > =4
Other Adverse Effects	:	Films formed on water may affect oxygen transfer and damage organisms.

13. DISPOSAL CONSIDERATIONS

Material Disposal	:	Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Waste arising from a spillage or tank cleaning should be disposed of in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand. Do not dispose into the environment, in drains or in water courses. Do not dispose of tank water bottoms by allowing them to drain into the ground. This will result in soil and groundwater contamination.
Container Disposal	:	Drain container thoroughly. After draining, vent in a safe place away from sparks and fire. Residues may cause an explosion hazard. Do not puncture, cut, or weld uncleaned drums. Send to drum recoverer or metal reclaimer. Do not pollute the soil, water or environment with the waste container.
Local Legislation	:	Disposal should be in accordance with applicable regional, national, and local laws and regulations. Local regulations may be more stringent than regional or national requirements and must be in compliance.

14. TRANSPORT INFORMATION

Land (as per ADR classification): Regulated

Class	:	3
Packing group	:	II
Hazard indentification no.	:	33
UN number	:	1203
Danger label (primary risk)	:	3
Proper shipping name	:	GASOLINE (UNLEADED)
Environmentally Hazardous	:	Yes

IMDG

Identification number	UN 1203
Proper shipping name	GASOLINE
Technical name	(UNLEADED)
Class / Division	3
Packing group	II
Environmental hazards:	Yes

IATA (Country variations may apply)

UN number	:	1203
Proper shipping name	:	Gasoline
Technical name	:	(UNLEADED)
Class / Division	:	3
Packing group	:	II

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Pollution Category	:	Not applicable.
Ship Type	:	Not applicable.
Product Name	:	Not applicable.
Special Precaution	:	Not applicable.
Additional Information	:	MARPOL Annex 1 rules apply for bulk shipments by sea.

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

Local Regulations

Workplace Safety and Health Act & Workplace	:	This product is subject to the requirement in the Act/ Regulations.

Safety and Health (General Provision) Regulations		
Environmental Protection and Management Act and Environmental Protection and Management (Hazardous Substances) Regulations	:	This product is subject to the requirement in the Act/ Regulations.
Maritime and Port Authority of Singapore (Dangerous Goods, Petroleum and Explosives) Regulations	:	This product is subject to the requirement in the Act/ Regulations.
Fire Safety Act and Fire Safety (Petroleum & Flammable Materials) Regulations	:	This product is subject to the requirement in the Act/ Regulations.
Classification triggering components	:	Contains gasoline, low boiling point naphtha, unspecified.

16. OTHER INFORMATION

Hazard Statement

H224	Extremely flammable liquid and vapour.
H225	Highly flammable liquid and vapour.
H302	Harmful if swallowed.
H303	May be harmful if swallowed.
H304	May be fatal if swallowed and enters airways.
H305	May be harmful if swallowed and enters airways.
H315	Causes skin irritation.
H316	Causes mild skin irritation.
H336	May cause drowsiness or dizziness.
H340	May cause genetic defects.
H350	May cause cancer.
H361	Suspected of damaging fertility or the unborn child.
H401	Toxic to aquatic life.
H402	Harmful to aquatic life.
H411	Toxic to aquatic life with long lasting effects.

Additional Information	:	This document contains important information to ensure the safe storage, handling and use of this product. The information in this document should be brought to the attention of the person in your organisation responsible for advising on safety matters.
SDS Version Number	:	1.0
SDS Effective Date	:	10.03.2014

Safety Data Sheet

SDS Revisions : A vertical bar (|) in the left margin indicates an amendment from the previous version.

Uses and Restrictions : This product must not be used in applications other than those recommended in Section 1, without first seeking the advice of the supplier.
This product is not to be used as a solvent or cleaning agent; for lighting or brightening fires; as a skin cleanser.
This product is designed only to suit automotive applications and no provision is made for the requirements of aviation applications.

SDS Distribution : The information in this document should be made available to all who may handle the product.

Key/Legend to Abbrevations used in this SDS : The standard abbreviations and acronyms used in this document can be looked up in reference literature (e.g. scientific dictionaries) and/or websites.

Flam. Liq.	Flammable liquids
Asp. Tox.	Aspiration hazard
Muta.	Germ cell mutagenicity
Carc.	Carcinogenicity
Skin Corr.	Skin corrosion/irritation
STOT SE	Specific target organ toxicity - single exposure
	Toxic for Reproduction

Key Literature References : The quoted data are from, but not limited to, one or more sources of information (e.g. toxicological data from Shell Health Services, material suppliers' data, CONCAWE, EU IUCLID date base, EC 1272 regulation, etc).

Disclaimer : This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

SAFETY DATA SHEET

Benzene

Section 1. Identification

GHS product identifier : Benzene

Chemical name : benzene

Other means of identification : benzene, purebenzol; cyclohexatriene; phenyl hydride; phene; coal naphtha; pyrobenzol

Product use : Synthetic/Analytical chemistry.

Synonym : benzene, purebenzol; cyclohexatriene; phenyl hydride; phene; coal naphtha; pyrobenzol

SDS # : 001062

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

Emergency telephone number (with hours of operation) : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE LIQUIDS - Category 2
SKIN CORROSION/IRRITATION - Category 2
SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2
GERM CELL MUTAGENICITY - Category 1B
CARCINOGENICITY - Category 1
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (bone marrow) - Category 1

GHS label elements

Hazard pictograms :



Signal word : Danger

Hazard statements : Highly flammable liquid and vapor.
May form explosive mixtures with air.
Causes serious eye irritation.
Causes skin irritation.
May cause genetic defects.
May cause cancer.
Causes damage to organs through prolonged or repeated exposure. (bone marrow)

Precautionary statements

General : Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.

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Section 2. Hazards identification

Prevention : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required. Wear protective gloves. Wear eye or face protection. Keep away from heat, sparks, open flames and hot surfaces. - No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Do not breathe vapor. Do not eat, drink or smoke when using this product. Wash hands thoroughly after handling.

Response : Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. IF SWALLOWED: Call a POISON CENTER or physician if you feel unwell. Rinse mouth. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing. If skin irritation occurs: Get medical attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.

Storage : Store locked up. Store in a well-ventilated place. Keep cool.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : benzene

Other means of identification : benzene, purebenzol; cyclohexatriene; phenyl hydride; phene; coal naphtha; pyrobenzol

CAS number/other identifiers

CAS number : 71-43-2

Product code : 001062

Ingredient name	%	CAS number
benzene	100	71-43-2

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

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Section 4. First aid measures

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention. If necessary, call a poison center or physician. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : No known significant effects or critical hazards.

Skin contact : Causes skin irritation.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : Harmful if swallowed. Irritating to mouth, throat and stomach.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation : No specific data.

Skin contact : Adverse symptoms may include the following:
irritation
redness

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

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Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use dry chemical, CO_2, water spray (fog) or foam.

Unsuitable extinguishing media : Do not use water jet.

Specific hazards arising from the chemical : Highly flammable liquid and vapor. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapor/gas is heavier than air and will spread along the ground. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

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Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapor or mist. Do not ingest. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Empty containers retain product residue and can be hazardous. Do not reuse container.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
benzene	**ACGIH TLV (United States, 3/2012).** **Absorbed through skin.** STEL: 8 mg/m³ 15 minutes. STEL: 2.5 ppm 15 minutes. TWA: 1.6 mg/m³ 8 hours. TWA: 0.5 ppm 8 hours. **NIOSH REL (United States, 1/2013).** STEL: 1 ppm 15 minutes. TWA: 0.1 ppm 10 hours. **OSHA PEL (United States, 6/2010).** STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours. **OSHA PEL 1989 (United States, 3/1989).** STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours. **OSHA PEL Z2 (United States, 11/2006).** AMP: 50 ppm 10 minutes. CEIL: 25 ppm TWA: 10 ppm 8 hours.

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Section 8. Exposure controls/personal protection

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Liquid. [Watery liquid.]

Color : Colorless. Yellowish.

Molecular weight : 78.12 g/mole

Molecular formula : C6-H6

Boiling/condensation point : 80.09°C (176.2°F)

Melting/freezing point : 5.49°C (41.9°F)

Critical temperature : 288.95°C (552.1°F)

Odor : Characteristic.

Odor threshold : Not available.

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Section 9. Physical and chemical properties

pH	:	Not available.
Flash point	:	Closed cup: -11°C (12.2°F)
Burning time	:	Not applicable.
Burning rate	:	Not applicable.
Evaporation rate	:	3.5 (butyl acetate = 1)
Flammability (solid, gas)	:	Not available.
Lower and upper explosive (flammable) limits	:	Lower: 1.2% Upper: 7.8%
Vapor pressure	:	10 kPa (75.006094245 mm Hg) [room temperature]
Vapor density	:	2.7 (Air = 1)
Specific Volume (ft^3/lb)	:	1.1403
Gas Density (lb/ft^3)	:	0.877 (20°C / 68 to °F)
Relative density	:	0.88
Solubility	:	Not available.
Solubility in water	:	1.88 g/l
Partition coefficient: n-octanol/water	:	2.13
Auto-ignition temperature	:	498°C (928.4°F)
Decomposition temperature	:	Not available.
SADT	:	Not available.
Viscosity	:	Dynamic (room temperature): 0.604 mPa·s (0.604 cP)

Section 10. Stability and reactivity

Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	:	The product is stable.
Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	:	Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow vapor to accumulate in low or confined areas.
Incompatibility with various substances	:	Highly reactive or incompatible with the following materials: oxidizing materials.
Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	:	Under normal conditions of storage and use, hazardous polymerization will not occur.

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Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
benzene	LC50 Inhalation Gas. LD50 Oral	Rat Rat	10000 ppm 930 mg/kg	7 hours -

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
benzene	Eyes - Moderate irritant Eyes - Severe irritant Skin - Mild irritant Skin - Mild irritant Skin - Moderate irritant	Rabbit Rabbit Rat Rabbit Rabbit	- - - - -	88 milligrams 24 hours 2 milligrams 8 hours 60 microliters 24 hours 15 milligrams 24 hours 20 milligrams	- - - - -

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Classification

Product/ingredient name	OSHA	IARC	NTP
benzene	+	1	Known to be a human carcinogen.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
benzene	Category 1	Not determined	bone marrow

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : No known significant effects or critical hazards.

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Section 11. Toxicological information

Skin contact : Causes skin irritation.

Ingestion : Harmful if swallowed. Irritating to mouth, throat and stomach.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation : No specific data.

Skin contact : Adverse symptoms may include the following:
irritation
redness

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : Causes damage to organs through prolonged or repeated exposure.

Carcinogenicity : May cause cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity : May cause genetic defects.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

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Section 12. Ecological information

Product/ingredient name	$LogP_{ow}$	BCF	Potential
benzene	2.13	11	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

United States - RCRA Toxic hazardous waste "U" List

Ingredient	CAS #	Status	Reference number
Benzene (I,T)	71-43-2	Listed	U019

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1114	UN1114	UN114	UN1114	UN1114
UN proper shipping name	BENZENE	BENZENE	BENZENE	BENZENE	BENZENE
Transport hazard class(es)	3 	3 	3 	3 	3 
Packing group	II	II	II	II	II
Environment	No.	No.	No.	No.	No.
Additional information	**Reportable quantity** 10 lbs / 4.54 kg [1.3675 gal / 5.1767 L] Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.	**Explosive Limit and Limited Quantity Index** 1 **Passenger Carrying Road or Rail Index** 5	-	-	**Passenger and Cargo Aircraft**Quantity limitation: 5 L **Cargo Aircraft Only** Quantity limitation: 60 L **Limited Quantities - Passenger Aircraft** Quantity limitation: 1 L

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Section 14. Transport information

	Limited quantity Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: 5 L **Cargo aircraft** Quantity limitation: 60 L **Special provisions** IB2, T4, TP1				

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): This material is listed or exempted.

Clean Water Act (CWA) 307: benzene

Clean Water Act (CWA) 311: benzene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard
Immediate (acute) health hazard
Delayed (chronic) health hazard

Composition/information on ingredients

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Section 15. Regulatory information

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
benzene	100	Yes.	No.	No.	Yes.	Yes.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	benzene	71-43-2	100
Supplier notification	benzene	71-43-2	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

California Prop. 65

WARNING: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

Ingredient name	Cancer	Reproductive	No significant risk level	Maximum acceptable dosage level
benzene	Yes.	Yes.	6.4 µg/day (ingestion) 13 µg/day (inhalation)	24 µg/day (ingestion) 49 µg/day (inhalation)

Canada inventory : This material is listed or exempted.

International regulations

International lists : **Australia inventory (AICS)**: This material is listed or exempted.
China inventory (IECSC): This material is listed or exempted.
Japan inventory: This material is listed or exempted.
Korea inventory: This material is listed or exempted.
Malaysia Inventory (EHS Register): Not determined.
New Zealand Inventory of Chemicals (NZIoC): This material is listed or exempted.
Philippines inventory (PICCS): This material is listed or exempted.
Taiwan inventory (CSNN): Not determined.

Chemical Weapons Convention List Schedule I Chemicals : Not listed

Chemical Weapons Convention List Schedule II Chemicals : Not listed

Chemical Weapons Convention List Schedule III Chemicals : Not listed

Canada

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Section 15. Regulatory information

WHMIS (Canada) : Class B-2: Flammable liquid
Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).

CEPA Toxic substances: This material is listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class B-2: Flammable liquid
Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).

Hazardous Material Information System (U.S.A.)

Health	*	2
Flammability		3
Physical hazards		0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

Date of printing : 4/26/2015.
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Date of previous issue : 10/16/2014.
Version : 0.03

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Section 16. Other information

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United NationsACGIH – American Conference of Governmental Industrial Hygienists
AIHA – American Industrial Hygiene Association
CAS – Chemical Abstract Services
CEPA – Canadian Environmental Protection Act
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
CFR – United States Code of Federal Regulations
CPR – Controlled Products Regulations
DSL – Domestic Substances List
GWP – Global Warming Potential
IARC – International Agency for Research on Cancer
ICAO – International Civil Aviation Organisation
Inh – Inhalation
LC – Lethal concentration
LD – Lethal dosage
NDSL – Non-Domestic Substances List
NIOSH – National Institute for Occupational Safety and Health
TDG – Canadian Transportation of Dangerous Goods Act and Regulations
TLV – Threshold Limit Value
TSCA – Toxic Substances Control Act
WEEL – Workplace Environmental Exposure Level
WHMIS – Canadian Workplace Hazardous Material Information System

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

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Conforms to Code of Practice for the Preparation of Safety Data Sheets for Hazardous Chemicals

SAFETY DATA SHEET

Agilent Technologies

Polynuclear Aromatic Hydrocarbon Standard, Part Number 8500-6035

Section 1. Identification

Product identifier : Polynuclear Aromatic Hydrocarbon Standard, Part Number 8500-6035

Part No. : 8500-6035

Relevant identified uses of the substance or mixture and uses advised against

Analytical chemistry.
500 ug/ml
1 ml

Supplier/Manufacturer : Agilent Technologies Australia Pty Ltd
679 Springvale Road
Mulgrave
Victoria 3170, Australia
1800 802 402

Emergency telephone number (with hours of operation) : CHEMTREC®: (61)-290372994

Section 2. Hazard(s) identification

Classification of the substance or mixture

H225	FLAMMABLE LIQUIDS - Category 2
H302	ACUTE TOXICITY (oral) - Category 4
H312	ACUTE TOXICITY (dermal) - Category 4
H332	ACUTE TOXICITY (inhalation) - Category 4
H315	SKIN CORROSION/IRRITATION - Category 2
H319	SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2A
H361	TOXIC TO REPRODUCTION (Unborn child) - Category 2
H336	SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3
H373	SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 2
H304	ASPIRATION HAZARD - Category 1
H400	ACUTE AQUATIC HAZARD - Category 1
H410	LONG-TERM AQUATIC HAZARD - Category 1

GHS label elements

Hazard pictograms :



Signal word : **DANGER**

Hazard statements :
H225 - Highly flammable liquid and vapour.
H302 + H312 + H332 - Harmful if swallowed, in contact with skin or if inhaled.
H319 - Causes serious eye irritation.
H315 - Causes skin irritation.
H361 - Suspected of damaging the unborn child.
H304 - May be fatal if swallowed and enters airways.
H336 - May cause drowsiness or dizziness.
H373 - May cause damage to organs through prolonged or repeated exposure.
H410 - Very toxic to aquatic life with long lasting effects.

Precautionary statements

Section 2. Hazard(s) identification

Prevention : P201 - Obtain special instructions before use.
P202 - Do not handle until all safety precautions have been read and understood.
P281 - Use personal protective equipment as required.
P280 - Wear protective gloves. Wear eye or face protection. Wear protective clothing.
P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P241 - Use explosion-proof electrical, ventilating, lighting and all material-handling equipment.
P242 - Use only non-sparking tools.
P243 - Take precautionary measures against static discharge.
P233 - Keep container tightly closed.
P271 - Use only outdoors or in a well-ventilated area.
P273 - Avoid release to the environment.
P260 - Do not breathe vapour.
P270 - Do not eat, drink or smoke when using this product.
P264 - Wash hands thoroughly after handling.

Response : P391 - Collect spillage.
P314 - Get medical attention if you feel unwell.
P308 + P313 - IF exposed or concerned: Get medical attention.
P304 + P340 + P312 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or physician if you feel unwell.
P301 + P310 + P330 + P331 - IF SWALLOWED: Immediately call a POISON CENTER or physician. Rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower.
P302 + P352 + P312 + P362-2 - IF ON SKIN: Wash with plenty of soap and water. Call a POISON CENTER or physician if you feel unwell. Take off contaminated clothing.
P332 + P313 - If skin irritation occurs: Get medical attention.
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 attention.

Storage : P405 - Store locked up.
P403 - Store in a well-ventilated place.
P235 - Keep cool.

Disposal : P501 - Dispose of contents and container in accordance with all local, regional, national and international regulations.

Supplemental label elements : Not applicable.

Other hazards which do not result in classification : None known.

Section 3. Composition and ingredient information

Substance/mixture : Mixture

CAS number/other identifiers

Ingredient name	% (w/w)	CAS number
Acetonitrile	≥30 - ≤60	75-05-8
Acetone	≥10 - ≤30	67-64-1
Toluene	≥10 - ≤30	108-88-3
Fluoranthene	≤0.1	206-44-0
Pyrene	≤0.1	129-00-0

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Section 3. Composition and ingredient information

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If necessary, call a poison center or physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Wash with plenty of soap and water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Get medical attention. If necessary, call a poison center or physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Get medical attention immediately. Call a poison center or physician. Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Aspiration hazard if swallowed. Can enter lungs and cause damage. Do not induce vomiting. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : Harmful if inhaled. Can cause central nervous system (CNS) depression. May cause drowsiness or dizziness.

Skin contact : Harmful in contact with skin. Causes skin irritation.

Ingestion : Harmful if swallowed. Can cause central nervous system (CNS) depression. May be fatal if swallowed and enters airways.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation : Adverse symptoms may include the following:
nausea or vomiting
headache
drowsiness/fatigue
dizziness/vertigo
unconsciousness
reduced foetal weight
increase in foetal deaths
skeletal malformations

Section 4. First aid measures

Skin contact : Adverse symptoms may include the following:
irritation
redness
reduced foetal weight
increase in foetal deaths
skeletal malformations

Ingestion : Adverse symptoms may include the following:
nausea or vomiting
reduced foetal weight
increase in foetal deaths
skeletal malformations

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Firefighting measures

Extinguishing media

Suitable extinguishing media : Use dry chemical, CO_2, water spray (fog) or foam.

Unsuitable extinguishing media : Do not use water jet.

Specific hazards arising from the chemical : Highly flammable liquid and vapour. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapour/gas is heavier than air and will spread along the ground. Vapours may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard. This material is very toxic to aquatic life with long lasting effects. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
nitrogen oxides
cyanides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Hazchem code : •3WE

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilt material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapour or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

Methods and material for containment and cleaning up

Methods for cleaning up : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Avoid exposure during pregnancy. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapour or mist. Do not swallow. Avoid release to the environment. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Empty containers retain product residue and can be hazardous. Do not reuse container.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls and personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Acetonitrile	**Safe Work Australia (Australia, 1/2014). Absorbed through skin.** STEL: 101 mg/m³ 15 minutes. STEL: 60 ppm 15 minutes. TWA: 67 mg/m³ 8 hours. TWA: 40 ppm 8 hours.
Acetone	**Safe Work Australia (Australia, 1/2014).** STEL: 2375 mg/m³ 15 minutes. STEL: 1000 ppm 15 minutes. TWA: 1185 mg/m³ 8 hours. TWA: 500 ppm 8 hours.
Toluene	**Safe Work Australia (Australia, 1/2014). Absorbed through skin.** STEL: 574 mg/m³ 15 minutes. STEL: 150 ppm 15 minutes. TWA: 191 mg/m³ 8 hours. TWA: 50 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapour or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Section 8. Exposure controls and personal protection

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use.

Section 9. Physical and chemical properties

Appearance

Physical state : Liquid. [Clear.]

Colour : Clear. Colourless.

Odour : Ether-like

Odour threshold : Not available.

pH : Not available.

Melting point : -45°C (-49°F)

Boiling point : 81.6°C (178.9°F)

Flash point : Closed cup: -18 to 23°C (-0.4 to 73.4°F)

Evaporation rate : 5.79 (butyl acetate = 1)

Flammability (solid, gas) : Not applicable.

Lower and upper explosive (flammable) limits : Not available.

Vapour pressure : 11.6 kPa (87 mm Hg) [room temperature]

Vapour density : 1.42 [Air = 1]

Relative density : Not available.

Solubility : Soluble in the following materials: cold water and hot water.

Partition coefficient: n-octanol/water : -0.34

Auto-ignition temperature : Not available.

Decomposition temperature : Not available.

Viscosity : Not available.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurise, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow vapour to accumulate in low or confined areas.

Incompatible materials : Reactive or incompatible with the following materials:
oxidizing materials
Incompatible with: reducing materials, metals, acids, alkalis and moisture.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Acetonitrile	LC50 Inhalation Vapour	Rat	17100 ppm	4 hours
	LD50 Oral	Rat	2460 mg/kg	-
Acetone	LD50 Oral	Rat	5800 mg/kg	-
Toluene	LC50 Inhalation Vapour	Rat	49 g/m³	4 hours
	LD50 Oral	Rat	636 mg/kg	-
Fluoranthene	LD50 Dermal	Rabbit	3180 mg/kg	-
	LD50 Oral	Rat	2 g/kg	-

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
Acetonitrile	Eyes - Moderate irritant	Rabbit	-	24 hours 100 microliters	-
	Skin - Mild irritant	Rabbit	-	500 milligrams	-
Acetone	Eyes - Mild irritant	Rabbit	-	10 microliters	-
	Eyes - Moderate irritant	Rabbit	-	24 hours 20 milligrams	-
	Skin - Mild irritant	Rabbit	-	24 hours 500 milligrams	-
	Skin - Mild irritant	Rabbit	-	395 milligrams	-
Toluene	Eyes - Mild irritant	Rabbit	-	0.5 minutes 100 milligrams	-
	Eyes - Mild irritant	Rabbit	-	870 Micrograms	-
	Skin - Mild irritant	Rabbit	-	435 milligrams	-
	Skin - Moderate irritant	Rabbit	-	24 hours 20 milligrams	-
	Skin - Moderate irritant	Rabbit	-	500 milligrams	-
Pyrene	Skin - Mild irritant	Rabbit	-	24 hours 500 milligrams	-

Conclusion/Summary

Skin : Repeated exposure may cause skin dryness or cracking.

Sensitisation

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
Acetone	Category 3	Not applicable.	Narcotic effects
Toluene	Category 3	Not applicable.	Narcotic effects

Section 11. Toxicological information

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
Toluene	Category 2	Not determined	Not determined

Aspiration hazard

Name	Result
Polynuclear Aromatic Hydrocarbon Standard, Part Number 8500-6035	ASPIRATION HAZARD - Category 1
Toluene	ASPIRATION HAZARD - Category 1

Information on likely routes of exposure : Routes of entry anticipated: Oral, Dermal, Inhalation.

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : Harmful if inhaled. Can cause central nervous system (CNS) depression. May cause drowsiness or dizziness.

Skin contact : Harmful in contact with skin. Causes skin irritation.

Ingestion : Harmful if swallowed. Can cause central nervous system (CNS) depression. May be fatal if swallowed and enters airways.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation : Adverse symptoms may include the following:
nausea or vomiting
headache
drowsiness/fatigue
dizziness/vertigo
unconsciousness
reduced foetal weight
increase in foetal deaths
skeletal malformations

Skin contact : Adverse symptoms may include the following:
irritation
redness
reduced foetal weight
increase in foetal deaths
skeletal malformations

Ingestion : Adverse symptoms may include the following:
nausea or vomiting
reduced foetal weight
increase in foetal deaths
skeletal malformations

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Section 11. Toxicological information

Potential chronic health effects

Not available.

General : May cause damage to organs through prolonged or repeated exposure.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : Suspected of damaging the unborn child.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value
Oral	850.5 mg/kg
Dermal	1871.1 mg/kg
Inhalation (vapours)	18.71 mg/l

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
Acetonitrile	Acute IC50 3685000 µg/l Fresh water	Aquatic plants - Lemna minor	96 hours
	Acute LC50 3600000 µg/l Fresh water	Daphnia - Daphnia magna	48 hours
	Acute LC50 1000000 µg/l Fresh water	Fish - Pimephales promelas	96 hours
	Chronic NOEC 1000000 µg/l Fresh water	Aquatic plants - Lemna minor	96 hours
	Chronic NOEC 160000 µg/l Fresh water	Daphnia - Daphnia magna	21 days
Acetone	Acute EC50 20.565 mg/l Marine water	Algae - Ulva pertusa	96 hours
	Acute LC50 6000000 µg/l Fresh water	Crustaceans - Gammarus pulex	48 hours
	Acute LC50 10000 µg/l Fresh water	Daphnia - Daphnia magna	48 hours
	Acute LC50 5600 ppm Fresh water	Fish - Poecilia reticulata	96 hours
	Chronic NOEC 4.95 mg/l Marine water	Algae - Ulva pertusa	96 hours
	Chronic NOEC 0.016 ml/L Fresh water	Crustaceans - Daphniidae	21 days
	Chronic NOEC 0.1 ml/L Fresh water	Daphnia - Daphnia magna - Neonate	21 days
Toluene	Acute EC50 12500 µg/l Fresh water	Algae - Pseudokirchneriella subcapitata	72 hours
	Acute EC50 11600 µg/l Fresh water	Crustaceans - Gammarus pseudolimnaeus - Adult	48 hours
	Acute EC50 6000 µg/l Fresh water	Daphnia - Daphnia magna - Juvenile (Fledgling, Hatchling, Weanling)	48 hours
	Acute LC50 5500 µg/l Fresh water	Fish - Oncorhynchus kisutch - Fry	96 hours
	Chronic NOEC 0.74 mg/l	Daphnia - Ceriodaphnia dubia	7 days
Fluoranthene	Acute EC50 0.103 ug/ml Marine water	Algae - Phaeodactylum tricornutum	72 hours
	Acute EC50 45 ppm Marine water	Algae - Skeletonema costatum	96 hours
	Acute LC50 5.32 µg/l Marine water	Crustaceans - Americamysis bahia	48 hours
	Acute LC50 8.7 µg/l Fresh water	Daphnia - Daphnia magna	48 hours
	Acute LC50 0.9 µg/l Marine water	Fish - Cyprinodon variegatus	96 hours
	Chronic NOEC 41.7 µg/l Fresh water	Algae - Pseudokirchneriella subcapitata	96 hours
	Chronic NOEC 95 µg/l Marine water	Aquatic plants - Plantae	72 hours
	Chronic NOEC 1.4 µg/l Fresh water	Daphnia - Daphnia magna	21 days
	Chronic NOEC 1.4 µg/l Fresh water	Fish - Pimephales promelas	32 days

Section 12. Ecological information

Pyrene	Acute LC50 0.89 µg/l Marine water Acute LC50 135.8 µg/l Fresh water	Crustaceans - Americamysis bahia Daphnia - Daphnia magna - Neonate	48 hours 48 hours

Persistence and degradability

Product/ingredient name	Test	Result	Dose	Inoculum
Acetone	OECD 301B Ready Biodegradability - CO2 Evolution Test	95 % - Readily - 28 days	-	-

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
Acetonitrile	-	-	Readily
Acetone	-	-	Readily
Toluene	-	-	Readily

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Polynuclear Aromatic Hydrocarbon Standard, Part Number 8500-6035	-0.34	-	low
Acetonitrile	-0.34	-	low
Acetone	-0.23	3	low
Toluene	2.73	90	low
Fluoranthene	5.16	3630.78	high
Pyrene	5.43	1513.56	high

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimised wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapour from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

Regulatory information

ADG / IMDG / IATA : Not regulated as Dangerous Goods according to the ADG Code .

Additional information : **Remarks**
De minimis quantities

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of Marpol and the IBC Code : Not available.

Section 15. Regulatory information

Standard Uniform Schedule of Medicine and Poisons

6, 5

Model Work Health and Safety Regulations - Scheduled Substances

No listed substance

Australia inventory (AICS) : Not determined.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Inform Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

International lists

National inventory

Canada : Not determined.

China : Not determined.

Europe : All components are listed or exempted.

Japan : **Japan inventory (ENCS)**: Not determined.
Japan inventory (ISHL): Not determined.

Malaysia : Not determined.

New Zealand : All components are listed or exempted.

Philippines : Not determined.

Republic of Korea : Not determined.

Taiwan : All components are listed or exempted.

Turkey : Not determined.

United States : Not determined.

Section 16. Any other relevant information

History

Date of issue/Date of revision : 09/06/2016

Date of previous issue : 30/06/2014.

Version : 6

Key to abbreviations : ADG = Australian Dangerous Goods
ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
NOHSC = National Occupational Health and Safety Commission
SUSMP = Standard Uniform Schedule of Medicine and Poisons
UN = United Nations

Procedure used to derive the classification

Classification	Justification
Flam. Liq. 2, H225	On basis of test data
Acute Tox. 4, H302	Calculation method
Acute Tox. 4, H312	Calculation method
Acute Tox. 4, H332	Calculation method
Skin Irrit. 2, H315	Calculation method
Eye Irrit. 2A, H319	Calculation method
Repr. 2, H361 (Unborn child)	Calculation method
STOT SE 3, H336	Calculation method
STOT RE 2, H373	Calculation method
Asp. Tox. 1, H304	Expert judgment
Aquatic Acute 1, H400	Calculation method
Aquatic Chronic 1, H410	Calculation method

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

Disclaimer: The information contained in this document is based on Agilent's state of knowledge at the time of preparation. No warranty as to its accurateness, completeness or suitability for a particular purpose is expressed or implied.







Material Safety Data Sheet
Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth. Repeated or prolonged exposure to the substance can produce target

organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Non combustible. Calcium carbide reacts with hydrogen chloride gas with incandescence. Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine. Rubidium acetylene carbides burns with slightly warm hydrochloric acid. Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved. Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammble gas. Cesium acetylene carbide burns hydrogen chloride gas. Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute. Reacts with most metals to produce flammable Hydrodgen gas.

Special Remarks on Explosion Hazards:

Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl4 Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca3P2 Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO4 Hexalithium disilicide H2SO4 Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U3P4 , Vinyl acetate. Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
CEIL: 5 (ppm) from OSHA (PEL) [United States] CEIL: 7 (mg/m3) from OSHA (PEL) [United States] CEIL: 5 from NIOSH CEIL: 7 (mg/m3) from NIOSH TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)] TWA: 2 STEL: 8 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:
108.58 C @ 760 mm Hg (for 20.22% HCl in water) 83 C @ 760 mm Hg (for 31% HCl in water) 50.5 C (for 37% HCl in water)

Melting Point:
-62.25°C (-80°F) (20.69% HCl in water) -46.2 C (31.24% HCl in water) -25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:
1.1- 1.19 (Water = 1) 1.10 (20%and 22% HCl solutions) 1.12 (24% HCl solution) 1.15 (29.57% HCl solution) 1.16 (32% HCl solution) 1.19 (37% and 38%HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:
Highly reactive with metals. Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts with water especially when water is added to the product. Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C. Sodium reacts very violently with gaseous hydrogen chloride. Calcium phosphide and hydrochloric acid undergo very energetic reaction. It reacts with oxidizers releasing chlorine gas. Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates. Reacts with most metals to produce flammable Hydrogen gas. Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure) Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid. Adsorption of Hydrochloric Acid onto silicon dioxide results in exothmeric reaction. Hydrogen chloride causes aldehydes and epoxides to violently polymerize. Hydrogen chloride or Hydrochloric Acid in contact with the folloiwng can cause explosion or ignition on contact or

Special Remarks on Corrosivity:

Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinium, tantalum, silver, and certain alloys are exceptions). It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys. No corrosivity data on zinc, steel. Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
Acute oral toxicity (LD50): 900 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse]. Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, . Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Doses (LDL/LCL) LDL [Man] -Route: Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (fetoxicity). May affect genetic material.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Corrosive. Causes severe skin irritation and burns. Eyes: Corrosive. Causes severe eye irritation/conjuntivitis, burns, corneal necrosis. Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and larryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well has headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure, occur, particularly if exposure is prolonged. May affect the liver. Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomitting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophogeal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis). Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel. Chronic Potential Health Effects: dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Hydrochloric acid Illinois toxic substances disclosure to employee act: Hydrochloric acid Illinois chemical safety act: Hydrochloric acid New York release reporting list: Hydrochloric acid Rhode Island RTK hazardous substances: Hydrochloric acid Pennsylvania RTK: Hydrochloric acid Minnesota: Hydrochloric acid Massachusetts RTK: Hydrochloric acid Massachusetts spill list: Hydrochloric acid New Jersey: Hydrochloric acid New Jersey spill list: Hydrochloric acid Louisiana RTK reporting list: Hydrochloric acid Louisiana spill reporting: Hydrochloric acid California Director's List of Hazardous Substances: Hydrochloric acid TSCA 8(b) inventory: Hydrochloric acid TSCA 4(a) proposed test rules: Hydrochloric acid SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid SARA 313 toxic chemical notification and release reporting: Hydrochloric acid CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R34- Causes burns. R37- Irritating to respiratory system. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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Safety Data Sheet

Material Name: ISOBUTYLENE **SDS ID: 00233334**

* * * Section 1 - PRODUCT AND COMPANY IDENTIFICATION * * *

Material Name: ISOBUTYLENE

Manufacturer Information

ADVANCED GAS TECHNOLOGIES
1401 Stauffer Road
Palm, PA 18070-0035
Mfg Contact: Outside the US: 703-572-3887 (Collect Calls Accepted)

Phone: 1-800-416-2505

Emergency # 1-800-424-9300 (CHEMTREC

Chemical Family

hydrocarbons, aliphatic

Synonyms

Mtg msds 56; 2-Methylpropene; Isobutylene; Liquified petroleum gas; 2-Methyl-1-propene; L.p.g.; gamma-Butylene; Asym-dimethyl ethylene; UN 1055; RTECS: UD0890000

* * * Section 2 - HAZARDS IDENTIFICATION * * *

EMERGENCY OVERVIEW

Color: colorless
Physical Form: liquefied gas
Odor: petroleum odor
Health Hazards: central nervous system depression, difficulty breathing
Physical Hazards: Flammable gas. May cause flash fire.

POTENTIAL HEALTH EFFECTS

Inhalation

Short Term: irritation, nausea, vomiting, headache, symptoms of drunkenness, disorientation, tingling sensation, suffocation, convulsions, coma
Long Term: no information on significant adverse effects

Skin

Short Term: burns, frostbite
Long Term: no information is available

Eye

Short Term: irritation, frostbite, blurred vision
Long Term: no information on significant adverse effects

Ingestion

Short Term: frostbite
Long Term: no information is available

* * * Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS * * *

CAS	Component	Percent
115-11-7	Isobutylene	100.0

Component Related Regulatory Information

This product may be regulated, have exposure limits or other information identified as the following: Butylene (25167-67-3).

* * * Section 4 - FIRST AID MEASURES * * *

Inhalation

If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

Skin

If frostbite or freezing occur, immediately flush with plenty of lukewarm water (105-115 F; 41-46 C). DO NOT USE HOT WATER. If warm water is not available, gently wrap affected parts in blankets. Get immediate medical attention.

Eyes

Contact with liquid: Immediately flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

Ingestion

If a large amount is swallowed, get medical attention.

Note to Physicians

For inhalation, consider oxygen.

* * * Section 5 - FIRE FIGHTING MEASURES * * *

See Section 9 for Flammability Properties

NFPA Ratings: Health: 1 **Fire:** 4 **Reactivity:** 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

Flammable Properties

Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive above flash point.

Extinguishing Media

carbon dioxide regular dry chemical

Large fires: Flood with fine water spray.

Fire Fighting Measures

Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Stop leak if possible without personal risk. Let burn unless leak can be stopped immediately. For smaller tanks or cylinders, extinguish and isolate from other flammables. Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Evacuate if fire gets out of control or containers are directly exposed to fire. Evacuation radius: 500 meters (1/3 mile). Consider downwind evacuation if material is leaking. Stop flow of gas.

* * * Section 6 - ACCIDENTAL RELEASE MEASURES * * *

Occupational spill/release

Avoid heat, flames, sparks and other sources of ignition. Do not touch spilled material. Stop leak if possible without personal risk. Reduce vapors with water spray. Keep unnecessary people away, isolate hazard area and deny entry. Remove sources of ignition. Ventilate closed spaces before entering.

* * * Section 7 - HANDLING AND STORAGE * * *

Storage Procedures

Store and handle in accordance with all current regulations and standards. Grounding and bonding required. Subject to storage regulations: U.S. OSHA 29 CFR 1910.110. U.S. OSHA 29 CFR 1910.101. Keep separated from incompatible substances.

* * * Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION * * *

Component Analysis

Isobutylene (115-11-7)

ACGIH: 250 ppm TWA

Ventilation

Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

PERSONAL PROTECTIVE EQUIPMENT

Eyes/Face

For the gas: Eye protection not required, but recommended. For the liquid: Wear splash resistant safety goggles. Contact lenses should not be worn. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

Protective Clothing

For the gas: Protective clothing is not required. For the liquid: Wear appropriate protective, cold insulating clothing.

Glove Recommendations

Wear insulated gloves.

Respiratory Protection

Under conditions of frequent use or heavy exposure, respiratory protection may be needed.

Respiratory protection is ranked in order from minimum to maximum.

Consider warning properties before use.

Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode.

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

* * * Section 9 - PHYSICAL AND CHEMICAL PROPERTIES * * *

Physical State:	Gas	**Appearance:**	Not available
Color:	colorless	**Physical Form:**	liquefied gas
Odor:	petroleum odor	**Odor Threshold:**	Not available
Melting Point:	-140 °C	**Boiling Point:**	-7 °C
Flash Point:	-76 °C	**Vapor Pressure:**	3278 mmHg @ 37.7 °C
Vapor Density (air = 1):	1.9	**Specific Gravity (water = 1):**	0.5879 @ 25 °C
Water Solubility:	almost insoluble	**Auto Ignition:**	465 °C
Molecular Weight:	56.12	**Molecular Formula:**	C4-H8

Solvent Solubility

Soluble: organic solvents, alcohol, ether, sulfuric acid

* * * Section 10 - STABILITY AND REACTIVITY * * *

Chemical Stability

Stable at normal temperatures and pressure.

Conditions to Avoid

Avoid heat, flames, sparks and other sources of ignition. Minimize contact with material. Containers may rupture or explode if exposed to heat.

Materials to Avoid

oxidizing materials.

Decomposition Products

oxides of carbon

Possibility of Hazardous Reactions

Will not polymerize.

* * * Section 11 - TOXICOLOGICAL INFORMATION * * *

Component Analysis - LD50/LC50

The components of this material have been reviewed in various sources and the following selected endpoints are published:

Isobutylene (115-11-7)

Inhalation LC50 Rat: 620 mg/L/4H

Acute Toxicity Level

Isobutylene (115-11-7)

Non Toxic: inhalation.

Component Carcinogenicity

Isobutylene (115-11-7)

ACGIH: A4 - Not Classifiable as a Human Carcinogen

Target Organs

Isobutylene (115-11-7)

central nervous system.

* * * Section 12 - ECOLOGICAL INFORMATION * * *

Component Analysis - Aquatic Toxicity

No LOLI ecotoxicity data are available for this product's components.

* * * Section 13 - DISPOSAL CONSIDERATIONS * * *

Disposal Methods

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001.

Component Waste Numbers

The U.S. EPA has not published waste numbers for this product's components.

* * * Section 14 - TRANSPORT INFORMATION * * *

US DOT Information

Shipping Name: Isobutylene
UN/NA #: UN1055 **Hazard Class:** 2.1
Required Label(s): 2.1

TDG Information

Shipping Name: Isobutylene
UN #: UN1055 **Hazard Class:** 2.1
Required Label(s): 2.1

* * * Section 15 - REGULATORY INFORMATION * * *

U.S. Federal Regulations

None of this products components are listed under SARA Sections 302/304 (40 CFR 355 Appendix A), SARA Section 311/312 (40 CFR 370.21), SARA Section 313 (40 CFR 372.65), CERCLA (40 CFR 302.4), TSCA 12(b), or require an OSHA process safety plan.

SARA 311/312

Acute Health: Yes **Chronic Health:** No **Fire:** Yes **Pressure:** Yes **Reactive:** No

U.S. State Regulations

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Isobutylene ([1]related to: Butylene)	115-11-7	No	Yes	No	Yes	Yes	Yes[1]

Not regulated under California Proposition 65

Component Analysis - Inventory

Component	CAS	US	CA	EU	AU	PH	JP	KR	CN	NZ
Isobutylene	115-11-7	Yes	DSL	EIN	Yes	Yes	Yes	Yes	Yes	Yes

* * * Section 16 - OTHER INFORMATION * * *

Key / Legend

ACGIH - American Conference of Governmental Industrial Hygienists; ADR - European Road Transport; AU - Australia; BOD - Biochemical Oxygen Demand; C - Celsius; CA - Canada; CAS - Chemical Abstracts Service; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CN - China; CPR - Controlled Products Regulations; DFG - Deutsche Forschungsgemeinschaft; DOT - Department of Transportation; DSL - Domestic Substances List; EEC - European Economic Communicty; EINECS - European Inventory of Existing Commercial Chemical Substances; EPA - Environmental Protection Agency; EU - European Union; F - Farenheit; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; ICAO - International Civil Aviation Organization; IDL - Ingredient Disclosure List; IMDG - International Maritime Dangerous Goods; JP - Japan; Kow - Octanol/water partition coefficient; KR - Korea; LEL - Lower Explosive Limit; LOLI - List Of LIsts™ - ChemADVISOR's Regulatory Database; MAK - Maximum Concentration Value in the Workplace; MEL - Maximum Exposure Limits; NFPA - National Fire Protection Agency; NIOSH - National Institute for Occupational Safety and Health; NJTSR - New Jersey Trade Secret Registry; NTP - National Toxicology Program; NZ - New Zealand; OSHA - Occupational Safety and Health Administration; PH - Philippines; RCRA - Resource Conservation and Recovery Act; RID - European Rail Transport; RTECS - Registry of Toxic Effects of Chemical Substances®; SARA - Superfund Amendments and Reauthorization Act; STEL - Short-term Exposure Limit; TDG - Transportation of Dangerous Goods; TSCA - Toxic Substances Control Act; TWA - Time Weighted Average; UEL - Upper Explosive Limit; US - United States

End of Sheet 00233334

Attachment E-3
Physical Agent Data Sheets

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Alaska Department of Labor and Workforce Development
Labor Standards and Safety
3301 Eagle Street/PO Box 107022
Anchorage, Alaska 99510-7022
(907) 269-4955

PHYSICAL AGENT DATA SHEET

COLD STRESS

HYPOTHERMIA

FROSTBITE

Alaska Department of Labor and Workforce Development
Labor Standards and Safety
3301 Eagle Street/PO Box 107022
Anchorage, 99510-7022
(907) 269-4955

Physical Agent Data Sheet

HYPOTHERMIA

Hypothermia is a temperature-related disorder. Therefore it is necessary to understand human physiology as it pertains to temperature stress.

Man is considered a tropical animal. Normal functioning of the human animal requires a body temperature of 37 degrees Celsius (98.6 degrees Fahrenheit). The body can self-compensate for small upward or downward variations in temperature through the activation of built-in thermoregulatory system, controlled by temperature sensors in the skin. The response to an upward variation in body temperature is the initiation of perspiration, which moves moisture from the body tissues to the body surface. When the moisture reaches the surface it evaporates, carrying with it a quantity of heat. The response to downward variation in body temperature is shivering, which is the body's attempt to generate heat. Shivering is an involuntary contraction and expansion of muscle tissue occurring on a large scale. This muscle action creates heat through friction.

THE DISORDER

Hypothermia is defined as a core temperature of the body less than 35 degrees Celsius (95 degrees Fahrenheit). Hypothermia is also considered the clinical state of sub-normal temperature when the body is unable to generate sufficient heat to efficiently maintain functions.

Many variables contribute to the development of hypothermia. Age, health, nutrition, body size, exhaustion, exposure, duration of exposure, wind, temperature, and wetness of body or clothes, medication and intoxicants (alcohol) may decrease heat production or increase heat loss.

The healthy individual's compensatory responses to heat loss via conduction, convection, radiation, evaporation and respiration may be overwhelmed by exposure. Medication may also interfere with heat generation or regulation. Children will have different symptoms than adults depending on the severity of the cold.

Definitions:

Conduction: Direct transfer of heat by contact with a cooler object
Convection: Cool air moving across the surface of the body, heat is transferred to the cool air warming the air.
Radiation: Heat radiated outward from the warm body to the cooler environment.
Evaporation: The process of losing heat from the body by vaporization of water from the body surface.
Respiration: Inspired air raised to body temperature that is then exhaled.

Each of these causes of heat loss can play a large or small role in the development of hypothermia, depending on clothing, head cover, wind, weather, etc.

Once hypothermia develops, two body compartments, the shell (skin) and the core (the remainder of the body) share the heat deficit. The skin constitutes about 10% of a 150 pound mass.

Hypothermia can be recognized as impending, mild, moderate and severe. Below is a brief description of the various stages:

> Impending: Person's core temperature has decreased to 96.8 degrees Fahrenheit (36 degrees C). Individual will increase exercise in an attempt to warm up. The skin may become pale, numb and waxy. Muscles can become tense and shivering may begin. Fatigue and weakness may begin to show.
>
> Mild: Core temperature has dropped to 93.2 degrees Fahrenheit (34 degrees C). Intense, uncontrolled shivering has begun. The individual may still be alert and able to help self; however, movements become less coordinated and the coldness is causing some pain and discomfort.
>
> Moderate: Core temperature has dropped to 87.7 degrees Fahrenheit (31 degrees C). Shivering slows or stops completely, mental confusion and apathy set in. Speech is slow and slurred. Breathing becomes slow and shallow followed by with drowsiness.
>
> Severe: Core temperature is below 87.7 degrees Fahrenheit (31 degrees C). Skin may have a blue-gray color; iris of the eyes may be dilated, may appear drunk, denies problems and may refuse help. This leads to a gradual loss of consciousness. There may be little or no breathing, lack of response to verbal or painful stimuli and may appear dead.

(Temperatures used in above descriptions are approximate. Symptoms may start at different temperatures depending on the individual and circumstances.)

Treatment Preface

Always act on the fact that **"no one is dead until warm and dead."**

Think ABCD – Airway, Breathing, Circulation and Degrees.

In sudden exposure to cold water there is a greater chance for resuscitation with sudden submersion and with prolonged exposure to cold water. Quick onset of hypothermia, easy to reverse. Slow onset, the harder to reverse the process.

The sole consensus regarding prehospital treatment is that all patients at some point should be rewarmed. Core first then extremities. The best way to rewarm the core is by warm air and warm IV solutions.

Initial management principles emphasize prevention of further heat loss, rewarnimg as soon as is safely possible at a "successful" rate and rewarming the core before the shell, in an attempt to avoid inducing lethal side effects during rewarming. This treatment goal is important, since hypothermia itself may not be fatal above 77 degrees Fahrenheit (25 degrees C) core temperature.

The person must be handled very carefully and gently and not be allowed to exercise, as muscular action can pump cold blood to the heart.

Cold blood going to the heart can cause ventricular fibrillation

Hypothermia causes several reactions within the body as it tries to protect itself and retain its heat. The most important of these is vasoconstriction, which halts blood flow to the extremities in order to conserve heat in the core of the body.

Treatment of Hypothermia

Be able to recognize the symptoms of hypothermia in yourself and others. The victim may deny he/she is in trouble. Even mild symptoms demand attention:

Impending: Seek or build a shelter to get the person out of the cold, windy, wet environment.
Start a fire or get a cookstove going to provide warmth. Provide the person with a hot drink (no alcohol, coffee or tea). Insulate the person with extra clothes.

Mild: Remove or insulate the patient from the cold ground, protect from the wind, eliminate evaporative heat loss with a vapor barrier. Keep the head and neck covered, remove to a warm environment. Consider covering patient's mouth and nose with a light fabric to reduce heat loss through breathing. Provide the person with a warm, sweetened drink (no alcohol, coffee or tea) and some high-energy food. Limited exercise may help to generate some internal heat, but it depletes energy reserves.

Moderate: Remove the person from the cold environment, keeping the head and neck covered. Apply mild heat (comfortable to your elbow) to the head, neck chest, armpits and groin of the patient. Use hot water bottles, wrapped Thermo-pads, or warm moist towels. Do not place the hot water bottles next to the skin, wrap in cloth first. Offer sips of warm, sweetened liquids (no alcohol, coffee or tea) if the patient is fully conscious, beginning to rewarm and is able to swallow. Patient should be seen by a physician ASAP.

Severe: Place person in a prewarmed sleeping bag with one or two other people. Skin to skin contact in the areas of the chest (ribs) and neck is effective. Exhale warm air near the patient's nose and mouth, or introduce steam into the area. Keep the patient awake. Apply mild heat, with the aim of stopping temperature drop, not rewarming. If patient has lost consciousness be very gentle, as the heart is extremely sensitive. Check for pulse at the carotid artery. If there is any breathing or pulse, no matter how faint, do not give CPR but keep a very close watch for changes in breathing and heart beat (vital signs). If no pulse can be found begin CPR immediately, stopping only when the heart begins to beat or the person applying CPR cannot carry on any longer without endangering themselves.

In all of the above, it is imperative that the victim be removed out of the wet and windy weather, remove all wet clothing, and put the victim into dry clothing and a warm sleeping bag.

Recent research has concluded that the safest and most effective method of treating hypothermia is through inhalation rewarming. Equipment is available; however, out in the field, alternative methods which have been described must be used where equipment is lacking.

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Physical Agent Data Sheet

FROSTBITE

GENERAL INFORMATION

Frostbite is the freezing of some part of the body. Fingers, toes, and even whole arms and legs can be lost as a result of frostbite. Injuries can happen at home, in the cities and also in more isolated areas of the State.

In extreme cold it is important to prevent heat loss from as many areas of the body as possible. Exposed limbs and head are major areas of heat loss, but keeping enough blood flowing to the hands and feet is the key to preventing frostbite. The trunk and the head should be warm enough so that the brain is able to command the blood vessels in the hands and feet to open up and keep the extremities warm.

ESSENTIAL CLOTHING

This includes thermal underwear, insulated footwear or mukluks with liners; double mittens and a parka, preferably down-filled with a good ruff. A parka that can be opened at the neck to allow heat to escape will prevent overheating and sweating. Quilted or skin pants are necessary if no warm shelter is immediately available. Tight cloths, especially tight gloves or tight boots should not be worn. The tightness interferes with good circulation in the hands and feet. If there is a reduction in blood flow to these areas, then the possibility of frostbite increases as the extremity cools down.

FACTORS LEADING TO FROSTBITE

Tall thin persons are more likely to get frostbite than those of stocky build.

People in poor physical condition are more susceptible than those in good health.

Certain diseases slow down the blood flow in the hands and feet especially in elderly people.

Heavy smokers often have poor circulation in the vital organs and decreased circulation in the arms and legs.

Children and elderly people who cannot produce large amounts of body heat for long periods of time can experience a lowering of deep body temperature and frostbite.

Alcohol causes the blood vessels to dilate (become larger). This leads to a false sense of warmth. This also leads to faster loss of heat from the body because of dilation of blood vessels. More important, people act with poor judgment after drinking.

Don't touch cold metal with bare or wet hands. You will freeze to the metal and tear the skin if pulled away without proper thawing with warm water, heat or urine.

Be careful when handling gasoline, kerosene or liquids other than water. Contact with bare skin in cold temperatures can cause instant frostbite.

> *Frostbite is more likely to occur when you are injured, frightened or careless*.

HOW TO RECOGNIZE FROSTBITE

Exposed parts of the body should be inspected routinely. This is done best with a partner. Just before freezing, the skin, especially the face with its many blood vessels, becomes bright red. Then small patches of white appear, as freezing actually occurs.

The loss of the sensations of touch, pressure and pain may occur without awareness of any numbness or other sensations. Therefore, it is important to test these sensations often. Wear clothing that is not restrictive but loose.

There may be no pain associated with frostbite if the freezing or temperature change is slow. Only if there is a rapid change in temperature does the body register pain.

The skin becomes less elastic. This is best noted in the finger pads. If touched or squeezed the pads will remain pitted. Any further cooling will result in frostbite.

Serious freezing is most common in the feet, followed by the hands and then the head (nose, ears). This is because of the poorer circulation in the feet and hands. Also with the poorer circulation there is in conjunction less sensation to these areas. Exposed head areas are less likely to freeze because of a better blood supply.

EARLY TREATMENT OF FROSTBITE

Early rewarming.

Thawing and refreezing should always be avoided.

Limbs should be rewarmed in stirred water just above normal body temperature (100 – 105 degrees Fahrenheit). Always use a thermometer to get accurate temperatures. Never try to thaw in cold water or snow. Since feeling is lost, fires, stoves, exhaust pipes, etc., should never be used. Serious damage to the skin could result.

Rewarming is an acutely painful experience and medication to alleviate pain should be given if available. After thawing, a deep aching pain may persist for several days, depending upon severity of the injury. Pain is a good sign; this tells us that the nerves are still alive and functioning.

A dull purple color, swelling and/or blistering of the extremity after thawing indicate a more serious injury and require medical attention.

SUMMARY

Poor circulation and poor production of body heat will lower resistance to frostbite.

Most cases of frostbite occur as a result of lack of knowledge, careless preparation, unavoidable accident, or the effects of alcohol on judgment. Forethought can prevent injury.

If freezing does occur, proper rewarming in warm water will give maximum benefit. The injured limb should be handled gently and a medical judgment made of the extent of injury and the need for further treatment.

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Alaska Department of Labor and Workforce Development
Labor Standards and Safety Division

Physical Agent Data Sheet (PADS) - Heat Stress

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1. Description

Heat stress is caused by working in hot environments like laundries, bakeries, or around boilers or incinerators. Four environmental factors affect the amount of heat stress felt by employees in hot work areas: temperature, humidity, radiant heat (such as from the sun or a furnace), and air velocity. How well or how poorly an individual reacts to heat stress is dependent on personal characteristics such as age, weight, fitness, medical condition, and acclimatization.

The body has several methods of maintaining the proper internal body temperature. When internal body temperature increases, the circulatory system reacts by increasing the amount of blood flow to the skin so the extra heat can be given off.

Sweating is another means the body uses to maintain stable internal temperatures. When sweat evaporates, cooling results. However, sweating is effective only if the humidity level is low enough to permit evaporation and if the fluids and salts lost are replaced.

2. Health Effects—Heat Disorders

Heat stroke, the most serious health problem for workers in hot environments is caused by the failure of the body's internal mechanism to regulate its core temperature. Sweating stops and the body can no longer rid itself of excess heat. Signs include: mental confusion, delirium, loss of consciousness, convulsions or coma; a body temperature of 106 degrees Fahrenheit or higher; and hot dry skin which may be red, mottled or bluish. Victims of heat stroke will die unless treated promptly. While medical help should be called, the victim must be removed immediately to a cool area and his/her clothing soaked with cool water. He/she should be fanned vigorously to increase cooling. Prompt first aid can prevent permanent injury to the brain and other vital organs.

Heat exhaustion develops as a result of loss of fluid through sweating when a worker has failed to drink enough fluids or take in enough salt, or both. The worker with heat exhaustion still sweats, but experiences extreme weakness or fatigue, giddiness, nausea, or headache. The skin is clammy and moist, the complexion pale or flushed, and the body temperature normal or slightly higher. Treatment is usually simple: the victim should rest in a cool place and drink salted liquids. Salt tablets are not recommended. Severe cases involving victims who vomit or lose consciousness may require longer treatment under medical supervision.

Heat cramps, painful spasms of the bone muscles, are caused when workers drink large quantities of water but fail to replace their bodies' salt loss. Tired muscles, those used for performing the work, are usually the ones most susceptible to cramps. Cramps may occur during or after working hours and may be relieved by taking salted liquids by mouth or saline solutions intravenously for quicker relief, if medically determined to be required.

Fainting may be a problem for the worker unacclimatized to a hot environment who simply stands still in the heat. Victims usually recover quickly after a brief period of lying down. Moving around, rather that standing still, will usually reduce the possibility of fainting.

Heat rash, also known as prickly heat, may occur in hot and humid environments where sweat is not easily removed from the surface of the skin by evaporation. When extensive or complicated by infection, heat rash can be so uncomfortable that it inhibits sleep and impairs a worker's performance or even results in temporary total disability. It can be prevented by showering, resting in a cool place, and allowing the skin to dry.

3. Medical Conditions Aggravated By Exposure to Heat

Persons with heart or circulatory diseases or those who are on "low salt" diets should consult with their physicians prior to working in hot environments.

4. Preventing Heat Disorders

One of the best ways to reduce heat stress on workers is to minimize heat in the workplace. However, there are some work environments where heat production is difficult to control, such as when furnaces or sources of steam or water are present in the work area, or when the workplace itself is outdoors and exposed to varying warm weather conditions.

5. Acclimatization

Humans are, to a large extent, capable of adjusting to the heat. This adjustment to heat, under normal circumstances, usually takes about 5 to 7 days, during which time the body will undergo a series of changes that will make continued exposure to heat more endurable.

On the first day of work in a hot environment, the body temperature, pulse rate, and general discomfort will be higher. With each succeeding daily exposure, all of these responses will gradually decrease, while the sweat rate will increase. When the body becomes acclimated to the heat, the worker will find it possible to perform work with less strain and distress.

Gradual exposure to heat gives the body time to become accustomed to higher environmental temperatures. Heat disorders in general are more likely to occur among workers who have not been given time to adjust to working in the heat or among workers who have been away from hot environments and who have gotten accustomed to lower temperatures. Hot weather conditions of the summer are likely to affect the worker who is not acclimatized to heat. Likewise, workers who return to work after a leisurely vacation or extended illness may be affected by the heat in the work environment. Whenever such circumstances occur, the worker should be gradually reacclimatized to the hot environment.

6. Lessening Stressful Conditions

Many industries have attempted to reduce the hazards of heat stress by introducing engineering controls, training workers in the recognition and prevention of heat stress, and implementing work-rest cycles. Heat stress depends, in part, on the amount of heat the worker’s body produces while a job is being performed. The amount of heat produced during hard, steady work is much higher than that produced during intermittent or light work. Therefore, one way of reducing the potential for heat stress is to make the job easier or lessen its duration by providing adequate rest time. Mechanization of work procedures can often make it possible to isolate workers from the heat source (perhaps in an air-conditioned booth) and increase overall productivity by decreasing the time needed for rest. Another approach to reducing the level of heat stress is the use of engineering controls which include ventilation and heat shielding.

7. Number and Duration of Exposures

Rather than be exposed to heat for extended periods of time during the course of a job, workers should, wherever possible, be permitted to distribute the workload evenly over the day and incorporate work-rest cycles. Work-rest cycles give the body an opportunity to get rid of excess heat, slow down the production of internal body heat, and provide greater blood flow to the skin.

Workers employed outdoors are especially subject to weather changes. A hot spell or a rise in humidity can create overly stressful conditions. The following practices can help to reduce heat stress:

- Postponement of nonessential tasks
- Permit only those workers acclimatized to heat to perform the more strenuous tasks, or
- Provide additional workers to perform the task keeping in mind that all workers should have the physical capacity to perform the task and that they should be accustomed to the heat.

8. Thermal Conditions in the Workplace

A variety of engineering controls can be introduced to minimize exposure to heat. For instance, improving the insulation on a furnace wall can reduce its surface temperature and the temperature of the area around it. In a laundry room, exhaust hoods installed over those sources releasing moisture will lower the humidity in the work area. In general, the simplest and least expensive methods of reducing heat and humidity can be accomplished by:

- Opening windows in hot work areas,
- Using fans, or
- Using other methods of creating airflow such as exhaust ventilation or air blowers.

9. Rest Areas

Providing cool rest areas in hot work environments considerably reduces the stress of working in those environments. There is no conclusive information available on the ideal temperature for a rest area. However, a rest area with a temperature near 76 degrees Fahrenheit appears to be adequate and may even feel chilly to a hot, sweating worker, until acclimated to the cooler environment. The rest area should be as close to the workplace as possible. Individual work periods should not be lengthened in favor of prolonged rest periods. Shorter but frequent work-rest cycles are the greatest benefit to the worker.

10. Drinking Water

In the course of a day's work in the heat, a worker may produce as much as 2 to 3 gallons of sweat. Because so many heat disorders involve excessive dehydration of the body, it is essential that water intake during the workday be about equal to the amount of sweat produced.

Most workers exposed to hot conditions drink less fluids than needed because of an insufficient thirst drive. A worker, therefore, should not depend on thirst to signal when and how much to drink. Instead, the worker should drink 5 to 7 ounces of fluids every 15 or 20 minutes to replenish the necessary fluids in the body. There is no optimum temperature of drinking water, but most people tend not to drink warm or very cold fluids as readily as they will cool ones. Whatever the temperature of the water, it must be palatable and readily available to the worker. Individual drinking cups should be provided, never use a common drinking cup.

Heat acclimatized workers lose much less salt in their sweat than do workers who are not adjusted to the heat. The average American diet contains sufficient salt for acclimatized workers even when sweat production is high. If, for some reason, salt replacement is required, the best way to compensate for the loss is to add a little extra salt to the food. Salt tablets <u>should not</u> be used. CAUTION: PERSONS WITH HEART PROBLEMS OR THOSE ON A "LOW SODIUM" DIET WHO WORK IN HOT ENVIRONMENTS SHOULD CONSULT A PHYSICIAN ABOUT WHAT TO DO UNDER THESE CONDITIONS.

11. Protective Clothing

Clothing inhibits the transfer of heat between the body and the surrounding environment. Therefore, in hot jobs where the air temperature is lower than skin temperature, wearing clothing reduces the body's ability to lose heat into the air.

When air temperature is higher than skin temperature, clothing helps to prevent the transfer of heat from the air to the body. The advantage of wearing clothing, however, may be nullified if the clothes interfere with the evaporation of sweat.

In dry climates, adequate evaporation of sweat is seldom a problem. In a dry work environment with very high air temperatures, the wearing of clothing could be an advantage to the worker. The proper type of clothing depends on the specific circumstance. Certain work in hot environments may require insulated gloves, insulated suits, reflective clothing, or infrared reflecting face shields. For extremely hot conditions, thermally-conditioned clothing is available. One such garment carries a self-contained air conditioner in a backpack, while another is connected to a compressed air source which feeds cool air into the jacket or coveralls through a vortex tube. Another type of garment is a plastic jacket which has pockets that can be filled with dry ice or containers of ice.

12. Recommended Exposure Limits

These Threshold Limit Values (TLVS) refer to heat stress conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse health effects. The TLVs shown in Table I are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38 degrees Celsius (100.4 degrees Fahrenheit).

Since measurement of deep body temperature is impractical for monitoring the workers' heat load, the measurement of environmental factors is required which most nearly correlate with deep body temperature and other physiological responses to heat. At the present time, Wet Bulb Globe Temperature Index (WBGT) is the simplest and most suitable technique to measure the environmental factors. WBGT values are calculated by the following equations:

Outdoors with solar load: WBGT = 0.7 NWB + 0.2 GT + 0.1 DB

Indoors or Outdoors with no solar load: WBGT = 0.7 NWB + 0.3 GT

Where: WBGT = Wet Bulb Globe Temperature Index
NWB = Natural Wet Bulb Temperature
DB = Dry Bulb Temperature
GT = Globe Temperature

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry bulb thermometer.

Higher heat exposures that shown in Table I are permissible if the workers have been undergoing medical surveillance and it has been established that they are more tolerant at work in heat than the average worker. Workers should not be permitted to continue their work when their deep body temperature exceeds 38.0 degrees Celsius (100.4 degrees Fahrenheit).

Table 1: Permissible Heat Exposure Threshold Limit Values

(Values are given in degrees Centigrade WBGT (Fahrenheit)]			
Work- Rest Regimen	**Work Load**		
	Light	**Moderate**	**Heavy**
Continuous work	30.0 (86.0)	26.7 (80.1)	25.0 (77.0)
75% Work, 25% Rest/Hour	30.6 (87.1)	28.0 (82.4)	25.9 (78.6)
50% Work, 50% Rest/Hour	31.4 (88.5)	29.4 (85.0)	27.9 (82.2)
25% Work, 75% Rest/Hour	32.2 (90.0)	31.1 (88.0)	30.0 (86.0)

13. References

- "Working in Hot Environments," US Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, 1986.
- "Threshold Limit Values and Biological Exposure Indices for 1986 - 1987," American Conference of Governmental Industrial, Hygienists, 6500 Glenway Avenue, Building D-7, Cincinnati, OH 45211-4438.

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Labor Standards and Safety Division

Physical Agent Data Sheet (PADS) - Hand-Arm Vibration

Description
Health Hazards
Vibration Syndrome
Vibration Induced White Finger
Stages
Carpal Tunnel Syndrome
Preventing Hand-Arm Vibration Diseases
Recommended Exposure Limits

Description

Hand-arm vibration is caused by the use of vibrating hand-held tools, such as pneumatic jack hammers, drills, gas powered chain saws, and electrical tools such as grinders. The nature of these tools involves vibration (a rapid back and forth type of motion) which is transmitted from the tool to the hands and arms of the person holding the tool.

Health Hazards

Vibration Syndrome and Vibration-Induced White Finger (VWF) are the major health hazards related to the use of vibrating tools. Carpal Tunnel Syndrome is another health problem that has been linked in one study to the use of smaller hand-held vibrating tools.

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Vibration Syndrome

Vibration Syndrome is a group of symptoms related to the use of vibrating tools and includes -some or all of the following: muscle weakness, muscle fatigue, pain in the arms and shoulders, and vibration-induced white finger. Many researchers believe that other symptoms--headaches, irritability, depression, forgetfulness, and sleeping problems--should also be included in descriptions of Vibration Syndrome.

Vibration-Induced White Finger

Vibration-Induced White Finger (VWF), also known as "Dead Finger" or "Dead Hand" is the result of impaired circulation (poor blood supply in the fingers, caused by the prolonged use of vibrating tools. VWF may appear after only several months on the job, or may not appear until twenty to forty years on the job.

The harmful health effects of vibrating tools are related to the length of time that a worker has been using vibrating tools and to the frequency of the vibration (how fast the tool goes back and forth). The longer a person uses a vibrating tool, and the faster the tool vibrates, the greater the risk of health effects. The length of the initial symptom-free period of vibration exposure (i.e., from first exposure to the first appearance of a white finger) is known as the latent interval. It is related to the intensity of the vibration - the shorter the latent period, the more severe the resulting VWF if vibration exposure continues.

Temporary tingling or numbness during or soon after use of a vibrating hand tool is not considered to be VWF, however tingling and numbness in the fingers lasting more than an hour after finishing work may indicate early stages of VWF. Table 1 lists the stages that Vibration White Finger may progress through if exposure continues.

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Table 1
Stages of Vibration White Finger
(Taylor-Pelmear System)

Stage	Condition of Fingers	Work & Social Interference
00	No tingling, numbness or blanching of fingers	No complaints
OT	Intermittent tingling	No interference with activities
ON	Intermittent numbness	No interference with activities
TN	Intermittent tingling and numbness	No interference with activities
1	Blanching of a fingertip with or without tingling and/or numbness	No interference with activities
2	Blanching of one or more fingers beyond tips, usually during winter	Possible interference with activities outside work, no interference at work
3	Extensive blanching of fingers; frequent episodes in both summer and winter	Definite interference at work, at home, and with social activities; restriction of hobbies
4	Extensive blanching of most fingers; frequent episodes in both summer and winter	Occupation usually changed because of severity of signs and symptoms

The technical name for VWF is Raynaud's Syndrome of Occupational Origin. Raynaud's Syndrome may also occur in people who do not use vibrating hand-held tools. Several different kinds of medical illnesses can cause Raynaud's Syndrome. Raynaud's Syndrome also appears in some people who are otherwise entirely healthy.

It is important that people with Raynaud's Syndrome avoid the extensive use of vibrating tools because they can develop the most severe complications of VWF very quickly.

Many of the symptoms of Vibration Syndrome will disappear shortly after a worker stops using the types of tools which transmit vibration to the hands and arms. Fatigue and muscular pain in the arms and shoulders will generally disappear. In the early stages, if a worker stops using vibrating tools, VWF will not get any worse and may get slightly better.

Carpal Tunnel Syndrome

Carpal Tunnel Syndrome (CTS) is a group of symptoms in the hand which arise from pressure on one of the nerves which passes through the palm side of the wrist. The early symptoms are similar to the early symptoms of white finger and consist of tingling in the fingers. For the most part only the thumb, index, and middle fingers are affected in CTS. Later, symptoms can progress to numbness. Pain in the wrist and fingers may also develop. CTS may occur in people using small hand tools like pneumatic screwdrivers. Carpal Tunnel Syndrome also occurs among people having repetitive motion of the wrist or fingers, such as using a cash register, or picking fish from a net; or with forceful motion of the wrist, such as in using a wrench. Pinching or flexing with the wrist bent upwards, downwards, or sideways increases the occurrence of CTS.

The symptoms of CTS are frequently worse at night and a person may be awakened from sleep by pain or the feeling of pins and needles in fingers, hand or wrist.

Carpal Tunnel Syndrome may improve if diagnosed in the early stages and exposure to the type of activity which caused it is stopped. In moderate cases most of the symptoms of CTS can be relieved by a surgical operation which relieves the pressure on the nerve which causes the CTS symptoms. If the surgery is performed too late, only some of the symptoms may be relieved. In very severe cases the symptoms are irreversible and may include weakness of the hand due to loss of muscle function.

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Preventing Hand-Arm Vibration Diseases

Job Modification to Reduce Vibration Exposure

Wherever possible, jobs should be redesigned to minimize the use of hand-held vibrating tools. Where job redesign is not feasible, ways to reduce tool vibration should be found. Where practical, substitute a manual tool for a vibrating tool. Whenever possible, high vibration tools should be replaced by improved, low vibration tools designed to absorb vibration before it reaches the handgrip.

Determine vibration exposure times and introduce work breaks to avoid constant, continued vibration exposure. A worker who is using a vibrating tool continuously should take a 10 minute break after each hour of using the tool.

Medical Evaluation

Workers whose occupations place them at risk for developing VWF should have pre-employment physicals and thereafter should be checked at least annually by doctors who know about the diagnosis and treatment of VWF. Diagnostic tests which can be used include plethysmography, arteriography, skin thermography, and sensory tests,, such as two point discrimination depth sense, pinprick touch and temperature sensation. X-rays may also be useful.

Workers that have a past history of abnormalities in blood circulation and especially workers who have Raynaudis Syndrome should not be permitted to use vibrating hand-held tools. Workers who have moderate to severe symptoms of VWF should be reassigned to work which removes them from further direct exposure to vibrating tools.

If workers develop symptoms of tingling or numbness, or if their fingers occasionally become white or blue, or painful especially when cold, they should be examined by a doctor who knows about the diagnosis and treatment of VWF and CTS.

Work Practices

Workers using vibrating hand-held tools should wear multiple layers of warm gloves and should wear anti-vibration gloves whenever possible. Before starting the job, warm the hands. This is especially important when it is cold. workers using vibrating tools should not allow the hands to become chilled. If the hands of a worker using vibrating tools become wet or chilled, he should dry them and put on dry, warm gloves before resuming exposure to vibration. Workers exposed to cold should dress adequately to keep the whole body warm because low body temperature can make a worker more susceptible to VWF.

A worker using a vibrating hand-held tool should let the tool do the work by grasping it as lightly as possible, consistent with safe work practice. The tighter the tool is held, the more vibration is transmitted to the fingers and hand. The tool should rest on a support or on the workpiece as much as possible. The tool should be operated only when necessary and at the minimum speed (and impact force) to reduce vibration exposure.

Tools should be regularly maintained to keep vibration to a minimum. Keeping chisels and chainsaws sharp, for example, will reduce vibration. Using new grinder wheels will also reduce vibration.

Education

Employees who use or will be using vibrating hand-held tools should receive training about the hazards of vibration and they should be taught how to minimize the ill effects of vibration.

Smokers are much more susceptible to VWF that non-smokers, and the VWF in smokers is usually more severe, therefore workers who use vibrating hand-held tools should not smoke.

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Recommended Exposure Limits

Table 2 contains the American Conference of Governmental Industrial Hygienists (ACGIH) recommendations on the limits for exposure of the hand to vibration.

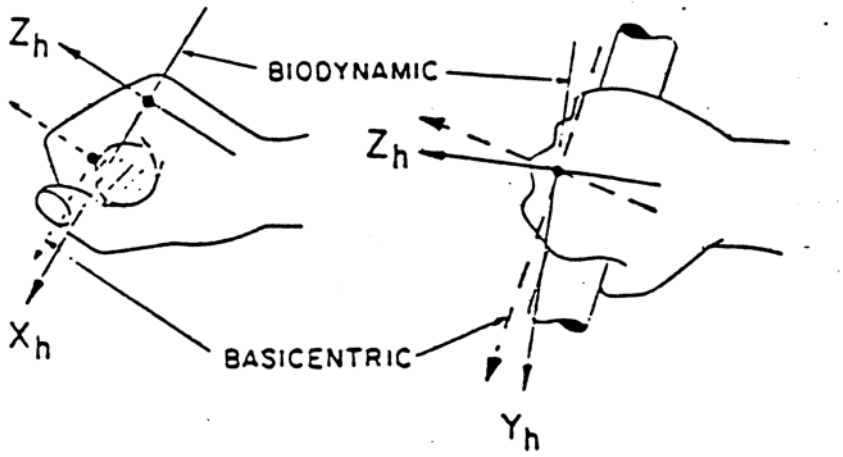
Table 2
Threshold Limit Values for Exposure of the Hand to Vibration in Either X_h, Y_h, Z_h, Directions

Total Daily Exposure Duration[a]	Values of the Dominant,[b] Frequency-Weighted, rms, Component Acceleration Which Shall Not be Exceeded a_k, (a_{keg})	
	m/s^2	g[c]
4 hours and less than 8	4	0.40
2 hours and less than 4	6	0.61
1 hour and less than 2	8	0.81
less than 1 hour	12	1.22

a The total time vibration enters the hand per day, whether continuously or intermittently.

b Usually one axis of vibration is dominant over the remaining two axes. If one or more vibration axes exceeds the Total Daily Exposure then the TLV has been exceeded.

c g = 9.81 m/s . d



Biodynamic and basicentric coordinate systems for the hand, showing the directions of the acceleration components (ISO 5349 and ANSI S3.34-1986).

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Alaska Department of Labor & Workforce Development
Occupational Safety and Health

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Physical Agent Data Sheet (PADS)
- Ionizing Radiation

- Description
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Description

Ionizing Radiation is the name given to a band of energy on the electromagnetic spectrum. X-rays and radioactive substances are examples of ionizing radiation. In order to understand the difference between ionizing and non-ionizing radiation it is necessary to review the structure of an atom.

All matter is made up of atoms. Molecules are collections of atoms hooked together in various combinations and shapes. An atom is the smallest unit of an element (like helium, oxygen or carbon) that still has all the properties of that element. Atoms are so small they cannot be seen with even the most powerful microscope.

All atoms are made up of three major subatomic particles: protons, neutrons, and electrons. Protons and neutrons make up the nucleus or center of the atom. Protons have a positive electric charge but neutrons have no electric charge. Electrons circle the nucleus and have a negative charge. In the neutral atom the negative charges of the electrons exactly balance the positive charges of the protons in the nucleus. If an atom has too many or too few electrons in orbit to balance the charge of the protons, the atom is called an ion.

The number of protons in the nucleus of an atom determines which element it is. Isotopes of the same element have the same number of protons but varying numbers of neutrons. The helium atom ($^{4}He_{2}$) has two protons and two neutrons in the nucleus. The carbon atom ($^{12}C_{6}$) has six protons and six neutrons in the nucleus. An example of

an unstable isotope of carbon is carbon-14 ($^{14}C_6$). The superscript indicates the atomic weight while the subscript number indicates the number of protons. If the atom has too many or too few neutrons for the number of protons, the atom may be unstable. If unstable the nucleus will give off bursts of energy (radiation) in an attempt to become stable.

These bursts of energy or disintegrations may be in the form of alpha particles (two protons and two neutrons - positively charged), beta particles (a negatively-charged electron), x-rays, or gamma rays (types of high energy electromagnetic waves). If these charged particles or waves interact with another atom, they have enough energy to knock an electron out of its orbit, creating an ion. That is why this type of radiation is called ionizing radiation.

Other forms of energy, like visible light, radio waves, and infrared light, do not have enough power to knock electrons out of their orbits so they are called non-ionizing radiation.

Amounts of ionizing radiation can be expressed in several different units. A **roentgen** (R) is an amount of x-rays or gamma radiation that causes a specified amount of ionization among the atoms and molecules in a cubic centimeter of air. Another unit is the **rad**, which applies to all ionizing radiation. It is a measure of the amount of energy absorbed from radiation in a specific volume of material.

A third unit, which is more useful and used more commonly, is the **REM** (Roentgen Equivalent Man). Measuring radiation in rems or millirems (one thousandth of a rem) allows direct comparison of the biological effects of different types of radiation. Alpha particles, beta particles, and x-rays or gamma radiation, differ in their ability to cause damage in tissues due to their differences in ionizing and penetrating ability. Alpha particles are 20 times more damaging in tissue then the same amount of x-rays. Measuring radiation in rems takes this difference into account so that one rem of alpha radiation in tissues has the same effect as one rem of beta radiation or one rem of x-rays. A rem is a relatively large quantity of radiation so most human exposures are measured in millirems. An easy way to remember the difference between these units is that a roentgen is a measure of how much you are exposed to, the rad is how much you absorb, and the rem is how much damage it does.

All people receive ionizing radiation from naturally occurring sources. Depending on where you live, most people receive an exposure in the range of 100 millirems per year from cosmic radiation from outer space and from naturally occurring isotopes (excluding radon) in the ground, air, food, and water. Radon is estimated to add another 200 millirems per year to our background. Medical and dental uses of x-rays can also contribute to a person's yearly radiation exposure. A typical well-conducted chest x-ray involves an exposure of 30 milliroentgens.

OCCUPATIONS WITH EXPOSURE TO IONIZING RADIATION

With the use of radioactive isotopes in industry and the increasing use of x-ray sources, ionizing radiation exposures may occur in a wide variety of occupations. The following examples show the diversity of occupations potentially exposed to ionizing radiation.

Aircraft workers	Military personnel
Atomic energy plant workers	Nuclear medicine workers with exposure to energetic radiation from selected radioisotopes (e.g. technetium-99m, iodine-131, tritium-3, etc.)
Biologists	Nurses
Cathode ray tube makers	Oil well loggers
Ceramic workers	Ore assayers
Chemists	Pathologists
Density testers	Petroleum refinery workers
Dental assistants	Physicians
Dentists	Physicists
Dermatologists	Pipeline oil flow testers
Drug makers	Pipeline weld radiographers
Drug sterilizers	Plasma torch operators
Electron microscope makers	Plastic technicians
Electron microscopists	Prospectors
Electrostatic eliminator operators	Radar tube makers
Embalmers	Radiologists
Fire alarm makers	Radium laboratory workers
Food preservers	Radium refinery workers
Food sterilizers	Research workers
Gas mantle makers	Television tube makers
High voltage television repairmen	Thickness gauge operators
High voltage vacuum tube makers	Thorium-aluminum alloy workers
High voltage vacuum tube users	Thorium-magnesium alloy workers
Industrial fluoroscope operators	Thorium ore producers
Industrial radiographers	Tile glaziers
Inspectors using, and workers in proximity to, sealed gamma ray Uranium sources (e.g. cesium-137, cobalt-60, and iridium-192)	Uranium dye workers
Klystron tube operators	Uranium mill workers
Liquid level gauge operators	Veterinarians
Luminous dial painters	X-ray technicians / aides
Machinists	X-ray diffraction apparatus operators
	X-ray tube makers, fabricated metal product

Health Effects
The health risks and effects of exposure to ionizing radiation are dependent on the type of radiation (alpha, beta, gamma or x-ray), the energy, the dose rate, the quantity, and the body part exposed.

Alpha particles, due to their relatively large size and mass, do not travel very far in air (a few centimeters) and cannot pass through skin or even a sheet of paper. Alpha radiation is only hazardous if inhaled or ingested. It is the most damaging to tissue if it is inhaled or ingested. Beta particles are more penetrating than alpha; a thin sheet of aluminum will stop beta radiation, but beta radiation is not as damaging to tissue.

X-rays (and gamma rays) are the most penetrating and least damaging to tissue. Their penetrating capability makes them useful for medical diagnoses.

Some body parts are more sensitive to damage from ionizing radiation than other body parts. The reproductive and blood-forming organs and the eyes are the most sensitive while the extremities such as arms, hands, and feet are less sensitive.

The quantity of ionizing radiation to which a person is exposed is the greatest factor in the risk and severity of a radiation-related injury. Information on the health effects of a single large dose of ionizing radiation is readily available from studies of the casualties and survivors of the atomic explosions in Hiroshima and Nagasaki, from studies of people exposed to radioactive fallout from the early atom bomb testing and from accidents involving ionizing radiation.

Health effects of a single acute dose of whole body radiation.	
Dose	**Acute Effects**
less than 25 rems	No detectable effect
25 - 50 rems	Drop in white blood cell count, no serious injury
50 - 100 rems	Possible injury and sickness; no disability
100 - 200 rems	Acute radiation sickness (nausea, vomiting, diarrhea, weakness, shock, skin sores, hair loss); possible disability
200 - 400 rems	Acute radiation sickness; disability certain, possible death without treatment
400 - 500 rems	50% death rate without treatment
> 600 rems	100% death rate

Occupational exposure to ionizing radiation is usually limited to a small area of the body such as the hands, resulting in reddening of the skin or dermatitis. Whole body radiation and acute radiation sickness occurs very rarely in occupational settings.

The health effects of long-term exposure to low levels of ionizing radiation are less easily studied and documented. The concern about possible health effects, cancer and genetic effects in particular, from low level radiation stems from the known health effects of high doses of radiation and the assumption that the degree of risk is directly related to the degree of exposure. It is assumed (not proven) for safety sake, that any exposure to radiation above natural background levels contributes to small increases in the risk of developing cancer. Reducing exposure to the lowest level possible will, therefore, reduce the risk to the lowest level possible.

Emergency Procedures

The following emergency procedures were developed for medical facilities but can be generally applied to any workplace where radioactive substances are used.

Initial report: All incidents involving environmental contamination should be reported first to the Alaska Department of Environmental Conservation Area Response Team (SOSC).

Southeast Alaska:	Bob Mattson (Juneau) Bob_mattson@dec.state.ak.us	907-465-5349
Central Alaska:	Gary Folley (Soldotna) Gary_folley@dec.state.ak.us	907-262-5210 ext 234
Northern Alaska:	Ed Meggert (Fairbanks) Ed_meggert@dec.state.ak.us	907-451-2124
Secondary report:	Doug Dasher (Fairbanks) Doug_dasher@dec.state.ak.us	907-451-2172

A. Spills

Accidental spillage of radioactive material is rare, but cannot be prevented absolutely, and may occur in any laboratory, in any hall or passageway traversed by messengers transporting such material.

Except for a major accident to a shipping container or a serious spill in the hot laboratory, the amount of radioactive material involved in a spill will usually be small and the radiation from it will not constitute a serious hazard. The real danger is the spread of the contamination on shoes or other contaminated garments. The following is a general outline of the procedure to be followed in the event of a spill.

- Confine the spill immediately by dropping paper towels or other absorbent material onto it.

- Put on waterproof gloves.

- Check shoes for visible signs of contamination. If it appears
- possible that they are contaminated, remove shoes when leaving the contaminated region.

- If fans, ventilators, or air conditioners are operating in the area, they should be shut off. Preferably this should be done by someone not involved in the spill and therefore not likely to spread contamination.

- Mark off or isolate in some way the entire suspect area and police it to be sure that no one walks through it.

- **CALL THE RADIATION PROTECTION SUPERVISOR (RPS)** (aka Radiological Safety Officer) designated by the employer. If the number is not posted in a convenient place, and you do not know it, call the company telephone operator, report an emergency and ask the operator to find the supervisor.

- In general, inexperienced personnel should not attempt to clean up a spill. It is better to wait a little while for the RPS than to risk spreading the contamination by erroneous procedures. If the spilled material is covered and bystanders are kept a few feet away, there is little or no danger from the radiation.

- If any of the spilled material has splashed onto a person or clothing, immediate steps should be taken to remove it. Laboratory coats or outer garments should be taken off and left in the contaminated area. Hands or other skin areas should be washed thoroughly with soap. If it is certain that shoes or feet are not contaminated, it is permissible to walk to a washing facility, which subsequently, however, must be treated as a contaminated area until cleared by the RPS. If there is doubt about contamination of the feet, a washbowl and soap should be brought to the suspect area for cleaning them.

- The RPS should bring decontamination materials and a survey meter, and the clean-up operation will proceed under the supervision of the RPS.

- If the RPS is not immediately available, or cleanup must proceed without him or her, one person should do the work. This person should put on waterproof

gloves, shoe covers and a surgical facemask if it is available. He will then take up the spilled material with absorbent paper, which must be handled with forceps or tongs, and deposit it immediately in a waterproof container. After as much as possible has been removed in this way, the surface should be washed with damp, not wet, rags held in forceps, always working toward the center of the contaminated area rather than away from it.

- A survey meter should have been obtained from the office of the RPS, and careful monitoring carried out during this procedure, on area and personnel. Preferably, the meter should be operated by someone not involved in the spill, so that the instrument is not likely to be contaminated.

- Reduction of counting rate to five times background, over an area of 1 or 2 square feet or to ten times background over a few square inches is usually satisfactory, especially for short-lived nuclides. Eventually, the RPS should check the area and give it clearance.

- When the operation is finished, gloves and other protective garments should be carefully checked for residual contamination. If any is found, the garments should be left with the other contaminated material for ultimate clearance or disposal by the RPS.

B. Loss of a Sealed Source

The following is a general outline of the procedure to be followed in the event of loss of a sealed source:

- Call the Radiation Protection Supervisor (RPS).

- If all sources are supposed to have been removed from the patient, he or she should be checked with a survey meter to make sure that none has inadvertently been left behind.

- Try to make sure that all bandages, linen, and bedding have been kept in the patient's room. If this is not the case, try to stop them on the way to the laundry or the incinerator.

- Check all this material, a little at a time. Then check the room, to be sure the source is not on the floor or furniture.

- Check the drain tap of any accessible plumbing facility.

- Check the incinerator.

- Check all barrels of ashes or garbage. The more active the source, the easier it should be to find it.

C. A Ruptured or Broken Sealed Source

- Shut off all fans and ventilators.
- Drop damp towels on the suspect material; throw nothing away.
- Call the Radiation Protection Supervisor. The RPS will remove the questionable material and check the area for contamination.
- If possible, evacuate the room. If not, keep all personnel several feet from the suspect material until the RPS arrives.

D. A Major Calamity: Fire, Earthquake, A Massive Spill

- Call the Radiation Protection Supervisor.
- Report the incident to the Alaska Department of Environmental Conservation Area Response Team (SOSC)
- Prevent access to suspect areas, or removal of anything from them. Shut off ventilating system; close drains if possible.
- Do not try to do anything until the RPS arrives. The RPS must be given complete charge.
- If for any reason the RPS cannot take charge, wait for the Alaska Department of Environmental Conservation Area Response Team (SOSC) or follow their instructions.

Medical Treatment

Medical treatment of a person who has been accidentally over exposed to ionizing radiation will depend on the dose. Exposures less than 25 rems generally do not require treatment. The treatment will also depend on whether the source of the radiation is outside the body such as from x-ray equipment or a gamma emitter, or from inside the body such as when a radioactive dust is inhaled or ingested.

When the source of radiation is outside the body, and treatment is considered necessary, it is started after the entire radiation dose has been received. The dose cannot be lessened, therefore the objective of the treatment is to lessen the acute effects of radiation sickness, prevent secondary infections and provide transfusions to supplement weakened and damaged blood cells.

When the source of the radiation (the emitter) has been inhaled or swallowed, radiation exposure will continue and the goal of treatment is to reduce the quantity of the emitter in the body. This may be accomplished by speeding up the excretion of the emitter by chelating therapy. A chelating agent is a chemical which binds with radioactive heavy metals enabling the body to excrete them faster. Chelating therapy is effective for internal emitters which are soluble in body fluids. Insoluble emitting substances which have been inhaled can be removed to some extent by bronchopulmonary lavage, a procedure which rinses out the lung's air sacs and airways.

Safety Procedures and Control Measures

The specific aspects, equipment, and procedures of a workplace radiation safety program will depend on the nature of the source, the type of radiation emitted, and the circumstances of its use. Only general concepts of protection and control can be covered in a data sheet of this scope. The National Council on Radiation Protection and Measurements (NCRP) offers recommendations for specific uses of radiation emitting substances and equipment. Publications from NCRP are available from their website: http://www.ncrp.com

Restricted Access: Only authorized trained personnel should be allowed in work areas where radiation emitting substances or equipment are used. Signs and warning notices using the standard radiation symbol must be posted.

Shielding: The selection of materials and designs for shielding will depend on the type of radiation, the use factor of the equipment, occupancy times, and workload.

Ventilation: Operations that routinely produce airborne contamination should utilize engineered containment and ventilation systems to prevent airborne releases. Appropriate respirators may be used but only when effective engineering controls are not feasible.

Radiation Monitoring: Radiation survey equipment appropriate for the type of radiation to be measured must be maintained and used to evaluate exposure conditions for employees. Working areas must be monitored at a frequency that will ensure safe working conditions. Individuals working in most industrial settings and many medical facilities must wear appropriate radiation monitoring devices to measure actual occupational exposures. Records of results for area and personal monitoring must be maintained.

Licensing and Registration: All by-product radioactive material and special nuclear material must be licensed by the Nuclear Regulatory Commission, and conditions of that license must be met by the user. Radioactive materials not under the jurisdiction of the Nuclear Regulatory commission and all x-ray sources must be registered with the

Alaska Department of Health and Social Services (H&SS), Radiological Health program. Use must meet requirements of the Alaska Radiation Protection Regulations, H&SS, in addition to the Occupational Safety and Health regulations of the Alaska Department of Labor & Workforce Development and the Environmental regulations of the Department of Environmental Conservation. The NRC and the state may conduct inspections of licensees and registrants to ensure compliance.

Consultation: Radiological Health is a program within the Department of Health and Social Services, State Public Health Laboratories. This program is responsible for safe use of radiation sources within the State of Alaska. Under Alaska statute, the program is responsible for Radiation Protection including the development of policies for evaluating radiation hazards, conducting surveys/investigations and training. This includes measurement and safe use of radiation, reviewing plans and shielding specifications for radiation sources, inspecting facilities where radiation sources are used, and contracting with other agencies where a cooperative effort is required in order to address radiation hazards. These responsibilities include both ionizing and non-ionizing sources, and radiation producing devices as well as radioactive materials. The main office is in Anchorage, however radon related activities are conducted out of the University of Alaska Fairbanks.

Contact: Clyde E. Pearce, RHS
Telephone: (907) 334-2107
Facsimile: (907) 334-2161
E-mail: clyde_pearce@health.state.ak.us

Emergency Response: Environmental surveys and disaster response to radiation in the environment are the responsibility of the Department of Environmental Conservation.

Initial report: All incidents involving environmental contamination should be reported first to the Alaska Department of Environmental Conservation Area Response Team (SOSC).

Southeast Alaska:	Bob Mattson (Juneau) Bob_mattson@dec.state.ak.us	907-465-5349
Central Alaska:	Gary Folley (Soldotna) Gary_folley@dec.state.ak.us	907-262-5210 ext 234
Northern Alaska:	Ed Meggert (Fairbanks) Ed_meggert@dec.state.ak.us	907-451-2124
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Personal Protective Equipment
Respirators used for protection against airborne contamination should be approved by the National Institute of Occupational Safety and Health (NIOSH). If air-purifying respirators are used, only high efficiency (HEPA) cartridges approved for dusts, fumes, mists, and radionuclides or radon daughters (progeny) may be used. A good respirator program must include consideration of respirator type, fit, maintenance, testing, and training.

Protective clothing must be provided if the potential for skin or clothing contamination exists. Selection must be based on the nature of the contaminant (liquid or dry material) and the type of radiation emitted. Appropriate methods of laundering or disposal are also required. Contaminated clothing must not be taken home.

Permissible Exposure Limit
The US DOL Occupational Safety and Health Administration (OSHA) regulations 29 CFR 1910.1096, adopted by reference by the State of Alaska under Alaska Administrative Code 8 AAC 61.1010(b), state that:

. . . (b) Exposure of individuals to radiation in restricted areas.

(1) No employer shall possess, use, or transfer sources of ionizing radiation in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from sources in the employer's possession or control a dose in excess of the limits specified in Table 1-18.

Table 1-18 **Rems per calendar quarter**	
Whole body: Head and trunk; active blood-forming organs; lens of eyes; or gonads	1 1/4
Hands and forearms; feet and ankles	18 3/4
Skin of whole body	7 1/2

(2) An employer may permit an individual in a restricted area to receive doses to the whole body greater that those permitted under 29 CFR 1910.1096 (b) (1) so long as:

(A) During any calendar quarter the dose to the whole body shall not exceed three rems; and

(B) The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed five (N-18) rems, where "N" equals the individual's age in years at his last birthday; and

(C) The employer maintains adequate past and current exposure records that show that the addition of such a dose will not cause the individual to exceed the amount authorized in this form. "Dose to the whole body" shall be deemed to include any dose to the whole body, gonad, active blood forming organs, head and trunk, or lens of the eye.

(3) No employer shall permit any employee who is under 18 years of age to receive in any period of one calendar quarter a dose in excess of 10 percent of the limits specified in Table 1-18.

These regulations (29 CFR 1910.1096) also cover definitions, exposure to airborne radioactive material, precautionary measures and personal monitoring, caution signs, labels and symbols, evacuation warnings, instruction of personnel, waste disposal, notification of incidents, reports of overexposure, records and disclosure.

References and Resources

1. Occupational Diseases - A Guide to Their Recognition, DHEW (NIOSH) Publication No. 77-181. 1978.

2. Radiation Protection for Medical and Allied Health Personnel, National Council on Radiation Protection and Measurements (NCRP) Report No. 48. 1986. Access NCRP publications at: http://www.ncrp.com

3. Cralley, Lewis J. and Cralley, Lester V. Patty's Industrial Hygiene and Toxicology Volume III, pg. 359 - 404, John Wiley and Sons, Inc. 1979.

4. OSHA General Industry Regulations, 29 CFR 1910, as amended, and adopted by the State of Alaska in Alaska Administrative Code, 8 AAC 61.1010(b) under the authority of AS 18.60.030, and specifically 29 CFR 1910.1096

   http://www.osha.gov/pls/oshaweb/owastand.display_standard_group?p_toc_level=1&p_part_number=1910

Physical Agent Data Sheet (PADS) - Lasers

A laser is a device which produces a concentrated beam of electromagnetic energy. The beam of energy can be in the form of visible light or in the form of invisible infrared or ultraviolet radiation.

Lasers differ in many ways, but there are certain characteristics which all lasers have in common. For all lasers, the production of the concentrated beam of energy requires three basic processes. First, an energy source is applied to a solid, gaseous or liquid substance called the lasing material. The lasing material then produces radiation having a specific wavelength. Then by using mirrors, lenses and shutters, the light or infrared waves or ultraviolet rays are magnified and focused to produce the laser beam.

Lasers may be different from one another in several specific ways. The basic categories are:

1. Type of lasing material used.

   The lasing material may be solid, like ruby crystals or glass; may be a gas or mixture of gases, such as carbon dioxide or a helium-neon mixture; or liquid containing special dyes.
2. Source of energy applied.

   The energy applied to the lasing material may come from a powerful light source, electric current, or a chemical reaction.
3. Continuous or pulsed emission of the laser beam.

   The energy applied to the lasing material may be continuous or applied on pulses. Some lasers can produce hundreds of thousands of pulses per second.

1.0 Hazards

The hazards related to the use of lasers vary depending on the type of laser, the power of the laser, the purpose and manner in which the laser is used, and the safety features of the laser.

Health Hazards

Eye injuries are the most serious danger from laser beams. The cornea of the eye is like a glass window that allows light to enter the eye. It is located in the very front part of the eyeball. The cornea is very sensitive and injuries to the cornea can be very painful. most injuries to the cornea heal without permanent damage. If the deep layers of the cornea are affected, permanent injuries can occur. The types of eye injuries which occur from improper use of lasers depend on the wavelengths of the laser beams. Laser injuries to the cornea are usually caused by lasers having short wavelengths in the ultraviolet and long wavelengths in the infrared ranges.

The lens of the eye is located toward the front of the eyeball but behind the cornea. Injuries to the lens can result in loss of transparency of the lens. The lens becomes cloudy and then blocks some of the light rays entering the eye, thus making it hard to create clear images on the retina. When the lens of the eye becomes cloudy, it is called a cataract. While damage to the cornea usually heals completely in a day or two, damage to the lens almost always persists. Very slight damage to the lens may go unnoticed, but repeated minimal damage can add up to serious damage later on. Damage to the lens may not cause problems until many years after the injuries to the lens occurred. Lens damage is most likely to occur with certain lasers that produce beams in the near-ultraviolet and near-infrared wavelength range.

The retina of the eye is the surface upon which visual images are produced. It is located in the back of the eyeball. Certain lasers in the wavelength ranges of visible light and near-infrared wavelength ranges can burn permanent blind spots in the retina causing partially or totally obscured vision.

Skin burns may also occur from the use of lasers but are less likely to occur and are less serious than eye injuries. When skin is exposed to a potentially dangerous laser beam, a person will usually feel the heat and remove the exposed part of the body from the path of the laser beam.

Electrical Hazards

Some lasers require high voltage power supplies and some workers have received electrical shock because of carelessness while working around these power supplies. Almost all laser power supplies under certain circumstances, could possible cause electrical shock or electrocution. Following the general safety standards for other electrical or electronic equipment provides protection against the dangers of electrical shock or electrocution.

Chemical Hazards

Laser welding or cutting of metals will cause formation of many of the same metal oxides and other fumes that are produced in conventional welding processes. Explosions can occur when ice collects in valves or connectors in lasers which require very cold liquids, such as liquid nitrogen.

Lasers are commonly used in the workplace to perform the following functions:

Welding and machining
Surgery
Communication: via fiber optic technology
Shock hardening, glazing, drilling
Cutting textiles
Leveling and alignment of building sites

2.0 Safety Classifications of Lasers

For safety purposes, lasers are divided into Classes I, II, III, and IV; Class I being least hazardous and Class IV most hazardous. Almost all reported eye injuries have been from Class IV lasers.

Almost all lasers that produce visible light beams are so bright that they can produce eye injuries. Therefore, to reduce risk of health hazards to the eye, many are designed in a way, such as enclosing the laser beam in a box, which prevents direct eye exposure to the beam.

Any laser which by itself is in Class II, III, or IV may be reclassified to a lower risk category if the laser beam is enclosed in such a way to decrease the risk of hazardous exposure to people.

Class I lasers are considered entirely safe even if used improperly. Class I lasers do not require any warning labeling. Some more hazardous lasers may be placed in the Class I category when they are part of a consumer or office machine which shields the user from the hazards of the laser beam. These machines, however, must have some type of warnings which are visible if the shields are removed.

Class II lasers are often referred to as "low-power" or "low-risk" lasers. These lasers are hazardous only when someone stares directly into the laser beam even though the beam hurts the eyes. Class II lasers require warnings to avoid staring directly into the beam.

Class III lasers are Moderate Risk or Medium Power lasers. They can produce eye injuries when the laser beams are viewed directly or when a sharp reflection is viewed directly. Class III is subdivided into Class IIIA and IIIB. Class IIIA is considered to be hazardous only when the laser beam is collected and focused by optical instruments, for example when surveyors look into a laser beam with a telescope-like instrument. Class IIIA lasers require warnings to prevent such hazardous practices. These lasers can cause serious eye injuries before someone who accidentally looks directly into the beam has a chance to blink.

Class IV lasers produce beams that when reflected, even if it is not a sharp reflection, may cause serious eye and skin injuries, and where the beam may be a fire hazard. It is critical that the dangers of Class IV lasers are clearly marked with warning signs.

3.0 Safety Precautions

Class I Controls

No user safety rules are necessary.

Class II Controls

1. Never permit a person to continuously stare into the laser source if exposure levels exceed the applicable permissible exposure level for the duration of intended staring.
2. Never point the laser at an individual's eye unless a useful purpose exists and the exposure level and duration will not exceed the permissible limit.

Class III Controls

1. Do not aim the laser at an individual's eye.
2. Permit only experienced personnel to operate the laser.
3. Enclose as much of the beam path as possible. Even a transparent enclosure will prevent individuals from placing their head or reflecting objects within the beam path. Terminations should be used at the end of the useful path of the direct and any secondary beams.
4. Shutters, polarizers and optical filters should be placed at the laser exit port to reduce the beam power to the minimal useful level.
5. Control spectators.
6. A warning light or buzzer should indicate laser operation. This is especially needed if the beam is not visible, e.g., for infrared lasers.
7. Do not permit laser tracking of nontarget vehicles or aircraft.
8. Operate the laser only in a restricted area, for example, in a closed room without windows, and place a warning sign on the door.
9. Place the laser beam path well above or well below the eye level of any sitting or standing observers whenever possible. The laser should be mounted firmly to assure that the beam travels only along its intended path.
10. Always use proper laser eye protection if a potential hazard exists for the direct beam or a specular reflection.
11. A key switch should be installed to minimize tampering by unauthorized individuals.
12. The beam or its specular reflection should never be directly viewed with optical instruments such as binoculars or telescopes without sufficient protective filters.
13. Remove all unnecessary mirror-like surfaces from within the vicinity of the laser beam path.

Class IV Controls

Fortunately, these high-power lasers are seldom used outside of research laboratories and restricted industrial environments where personnel access is carefully controlled.

These lasers should only be operated within a localized enclosure, or in a controlled workplace, or where the beam is directed into outer space. If a complete local enclosure is not possible, laser operation indoors should be in a light-tight room with interlocked entrances to assure that the laser cannot emit while a door is open.

1. Eye protection is needed for all individuals working within the controlled area. If the laser beam irradiance is sufficient to be a serious skin or fire hazard, a suitable shielding should be used between the laser beam and any personnel.
2. Remote firing with video monitoring or other remote (safe) viewing techniques should be chosen when feasible.
3. Outdoor high-power laser devices such as satellite laser transmission systems and laser radar (LIDAR) should have positive stops on the azimuth and elevation transverse to assure that the beam cannot intercept occupied areas or nontarget aircraft.
4. Beam shutters, beam polarizers, and beam filters should always be used to limit use to authorized personnel only. The flashlamps in optical pump systems should be shielded to eliminate any direct viewing.
5. Backstops should be diffusely reflecting-fire resistant target materials where feasible. Safety enclosures should be used around microwelding and microdrilling work pieces to contain hazardous reflections from the work area. Microscopic viewing systems used to study the work piece should ensure against hazardous levels of reflection of laser irradiation back through the optics.

4.0 Emergency Procedures

Anyone who is suspected of having a laser-related eye injury should be examined as soon as possible by an ophthalmologist, a physician who specializes in the care of eye injuries and diseases.

Laser-related skin burns should be treated as any other skin burns. Cold water should be applied immediately to the burn area for first and second degree burns (reddened skin or blistering skin). Third degree burns (open wound) should be covered with a sterile dressing and the person taken to a medical facility. Never put ointments, creams or butter on burns.

5.0 Permissible Exposure Limits

Lasers used in construction shall comply with the Alaska Construction Code, Section 05.040(e):

Nonionizing radiation

1. Only qualified and trained employees shall be assigned to install, adjust, and operate laser equipment.
2. Proof of qualification of the laser equipment operator shall be available and in posession of operator at all times.
3. The employer shall provide antilaser eye protection as specified in section 50 of this subchapter for employees working in areas where a potential exposure to direct or reflected laser light greater than 5 milliwatts exist.
4. Areas in which lasers are used shall be posted with standard laser warning placards.
5. Beam shutters or caps shall be utilized, or the laser turned off, when laser transmission is not actually required. The laser shall be turned off whenever the laser is left unattended.
6. Only mechanical or electronic means shall be used as a detector for guiding the internal alignment of the lasers.
7. The laser beam shall not be directed at employees.

8. Under conditions of rain, snow, fog or dust the use of laser systems is prohibited.
9. Laser equipment shall bear a label to indicate maximum output.
10. Employees shall not be exposed to light intensities above:
    a. Direct staring: one microwatt per square centimeter.
    b. Incidental observing: two and one-half watts per square centimeter.
    c. Diffused reflected light: two and one-half watts per square centimeter.
11. Laser units in operation shall be set up above the heads of the employees.

6.0 References

1. Sliney, D. & Walbarsht, M., Safety with Lasers and Other Optical Sources. Plenum Press, New York, NY 10013.

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Alaska Department of Labor and Workforce Development
Labor Standards and Safety
3301 Eagle Street/PO Box 107022
Anchorage, Alaska 99510-7022
(907) 269-4955

PHYSICAL AGENT DATA SHEET

Noise

Sound is created when a vibrating source (like a bell, motor or a stereo speaker) sends sound waves through the air to your ear. Every sound has two aspects: its pitch (frequency) and its loudness (intensity). On a stereo, frequency is determined by the bass/treble control. Intensity is determined by the volume control. Noise (unwanted sound) is usually made up of many frequencies. The disturbing and harmful effects of noise depend both on the loudness and the frequency of the tones making up noise.

Loudness is measured in units called decibels (dB). A conversational voice is about 65 dB. A shout is 90 dB or greater.

Frequency is measured in units called Hertz (Hz). The frequency of a locomotive horn is about 250 Hz. The frequency of a table saw is about 4,000 Hz.

Health Effects

Excessive noise can destroy the ability to hear, and may also put stress of other parts of the body, including the heart.

For most effects of noise, there is no cure, so that prevention of excessive noise exposure is the only way to avoid health damage.

Hearing

The damage done by noise depends mainly on how loud it is and on the length of exposure. The frequency or pitch can also have some effect, since high-pitched sounds are more damaging than low-pitched sounds.

Noise may tire out the inner ear, causing temporary hearing loss. After a period of time away from the noise hearing may be restored. Some workers who suffer temporary hearing loss may find that by the time their hearing returns to normal, it is time for another work shift so, in that sense, the problem is "permanent."

With continual noise exposure, the ear will lose its ability to recover from temporary hearing loss, and the damage will become permanent. Permanent hearing loss results from the destruction of cells in the inner ear, cells which can never be replaced or repaired. Such damage can be caused by long-term exposure to loud noise or, in some cases" by brief exposures to very loud noises.

Normally, workplace noise first affects the ability to hear high frequency (high-pitched) sounds. This means that even though a person can still hear some noise, speech or other sounds may be unclear or distorted.

Workers suffering from noise-induced hearing loss may also experience continual ringing in their ears, called "tinnitus." At this time, there is no cure for tinnitus, although some doctors are experimenting with treatment.

Other Effects

Although research on the effects of noise is not complete, it appears that noise can cause quickened pulse rate, increased blood pressure and a narrowing of the blood vessels over a long period of time, these may place an added burden on the heart.

Noise may also put stress on other parts of the body by causing the abnormal secretion of hormones and tensing of the muscles.

Workers exposed to noise sometimes complain of nervousness, sleeplessness and fatigue. Excessive noise exposure also can reduce job performance and may cause high rates of absenteeism.

Permissible Exposure Limit

The Action level for noise is an average noise level of 85 dB for an eight-hour day. When employees are exposed to noise levels, which exceed the Permissible Exposure Limit, the employer must install or use engineering or administrative controls to lower the noise levels. While these controls are being designed or installed employees must wear hearing protection. If the controls still do not reduce noise exposures to below 90 dB, hearing protection must continue to be worn.

Protective Measures

Suitable hearing protectors (earplugs or muffs) must be made available at no cost to employees who are exposed to an average of 85 dB or greater for an eight-hour day. Employees must be given the opportunity to select from three different types of appropriate hearing protectors.

Hearing tests (audiometric exams) must be given to employees who are exposed to an average of 85 dB or greater for an eight-hour day. Hearing tests will show whether employees are experiencing any hearing losses. Hearing tests are also useful in showing how well the earplugs and earmuffs are working. Hearing tests must be given annually.

Employees should also receive training in the effects of noise on hearing, an explanation of the hearing tests, and instruction on the proper fitting and care of earplugs or muffs.

Noise away from work can also cause hearing loss. Hearing protectors should be worn when operating noisy equipment or tools such as chain saws, brush cutters, power lawn mowers, or when using firearms.

Refer to Alaska Administrative Code, Occupational Health and Environmental Control 04.0104 for specific regulations on Noise Exposure and Hearing Conservation Programs.

Labor Standards and Safety Division

Physical Agent Data Sheet (PADS) - Radio Frequency/Microwave Radiation

Other PADS:
Cold Stress
Hand-Arm Vibration
Heat
Ionizing Radiation (PDF)
Lasers
Noise
Radio Waves
Ultraviolet Radiation

- Health Hazards
- Safety and Health Precautions
- Permissible Exposure Limits
- Microwave Ovens

Description

Radiofrequency and microwave radiation are both forms of energy called electromagnetic radiation. Sunshine contains three other forms of electromagnetic radiation: ultraviolet rays, infrared (heat) waves, and visible light waves.

These forms of energy are transmitted by waves. The distance between wave peaks is the "wavelength." The number of wave peaks passing a given point in one second is the "frequency."

Radiofrequency or radiowaves have a range of frequencies and wavelengths. Very High Frequency (VHF) radiowaves are used for TV and FM radio. Medium Frequency (MF) radiowaves are used for AM radio. Radiofrequency is used in heat sealers and glue driers.

Microwaves are actually just radiowaves of higher frequencies. Microwaves are used for radar and satellite communications, for telephone and TV transmissions, for microwave ovens, and for diathermy in medical clinics.

Electromagnetic radiation can interact with objects (or people) in three different ways. The energy waves can pass through an object without being changed, like light through a window. It can be reflected, like light off a mirror, or it can be absorbed and cause the object to heat up, like a sidewalk in the sun.

The health hazards of electromagnetic radiation are related only to the absorption of energy. The effects of absorbed energy depend on many different factors such as its wavelength and frequency, its intensity and duration. Different materials also absorb energy differently.

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Health Hazards

When microwaves or radiowaves are absorbed by body tissues, localized or spot heating can occur. The increased temperature can damage tissues, especially those with poor temperature control such as the lens of the eye.

Cataracts, clouding of the lens of the eye, may occur at the very high energy levels encountered close to radiating radar antennas. Heat damage to tissues is caused by high levels of exposure for short periods of time.

The health effects of low levels of exposure to radiowaves or microwaves for long periods of time are much harder to find and to prove. Some scientific studies show health effects from long-term, lowlevel exposure, other studies do not.

The following list includes health effects which some researchers suspect may be related to excessive radiofrequency/microwave exposure:

- Psychological changes, e.g., insomnia, irritability, mood swings,
- depression
- Headaches
- Nervous system abnormalities
- Hormonal changes
- Miscarriages and birth defects
- Male Infertility
- Altered immunity
- Leukemia

Of course, many of these health effects are relatively common, and most people having these problems have NOT had excessive exposure to radiofrequency/microwave radiation.

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Safety and Health Precautions

Employers who have people working around devices which produce radiofrequency/microwave radiation need to be sure that those devices are properly shielded to prevent leakage of radiation. Safety information regarding proper use and shielding of those devices can usually be obtained from owner/operators manuals, manufacturers, and the Alaska Department of Labor Occupational Safety and Health Section.

Radiofrequency sealers and heaters have been among the major sources of employee exposure to radiofrequency/microwave radiation. When these machines are used, employees should use mechanical or electrical devices that allow them to stay as far away form the source of radiation as possible. Whenever possible, these sealers should be turned off when not being used. Maintenance and adjustment of this type of equipment should be performed only by trained technicians and only when the machines are turned off.

Warnings should be posted to keep everyone away from the source of radiation except for those workers who are absolutely essential to performing the job.

People who are regularly exposed to significant levels of radiofrequency/microwave radiation should have preemployment and annual physical exams. The doctors should pay careful attention to the eyes to look for cataracts, to the nervous system for any abnormalities to the blood, to detect any early evidence of leukemia, and to the reproductive system to detect any abnormalities. Information concerning the frequency and intensity of the radiation exposures and duration of exposures should be provided to the physician.

In work areas where there is known or suspected to be significant amounts of radiofrequency/microwave radiation present, specialists should measure the amounts of radiation present. If excessive radiofrequency/microwave radiation is detected, modifications in the workplace should be made to reduce radiation exposure of workers. Afterwards, additional measurements should be made to determine if the radiation exposure has been reduced.

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Permissible Exposure Limits

The State of Alaska's permissible exposure limit is specified in Article I of Subchapter 4, Occupational Health and Environmental Control Code [04.0106 (a)], Alaska Occupational Safety and Health Standards. For normal environmental conditions and for incident electromagnetic energy of frequencies from 10 MHz to 100 GHz, the radiation protection guide is 10 mW/cm (milliwatts per square centimeter) as averaged over any possible six-minute period.

Further information can be obtained from the Alaska Department of Labor, Occupational Safety and Health Section.

Microwave Cooking Ovens

Microwave ovens used for heating food, when used in accordance with manufacturer's instructions, do not expose personnel to microwave radiation.

Microwave ovens do not need to be included in an employer's Hazard Communication program.

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Labor and Workforce Development || Job Seeker || Employer || Worker

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Labor Standards and Safety Division

Physical Agent Data Sheet (PADS) - Ultraviolet Radiation

Other PADS:
Cold Stress
Hand-Arm Vibration
Heat
Ionizing Radiation (PDF)
Lasers
Noise
Radio Waves
Ultraviolet Radiation

Description
Health Hazards
Skin Safety and Health Precautions
First Aid Procedures
Recommended Exposure Limits
Recommended Values
Reference

Description

Ultraviolet (UV) is the name for a band of energy on the electromagnetic spectrum that lies between visible light and x-rays. UV has some of the properties of visible light and other properties of the x-rays. Like visible light, some UV is actually visible but most is invisible like x-rays. UV, like light, cannot penetrate very far into most solids. Some UV, like x-rays, can ionize atoms or molecules which visible light cannot do.

Common sources of UV include the sun (especially when reflected by water, snow or ice), sun tanning lamps, mercury discharge lamps, welding arcs, plasma torches, and some lasers.

Health Hazards

The nature and seriousness of UV injuries depend on the length of exposure, the intensity of the UV, the type or wavelength of UV, the sensitivity of the individual, and the presence of certain chemicals (photosensitizers).

Skin

UV from the sun causes sunburns and skin cancer. UV from other sources can also cause skin burns varying in degree from mild reddening of the skin (first degree burns) to more severe and painful blistering (second degree burns). Long-term skin exposure to UV can cause actinic skin (a dry, brown, inelastic wrinkled skin) and skin cancer. Fair skinned individuals are more likely to develop both sunburns and skin cancer.

Some drugs, such as the antibiotic tetracycline, can cause skin burns from UV to happen faster and to be more severe. Products containing coal tar can also cause this reaction. These substances are called photosensitizers.

UV exposure may trigger cold sores (Herpes Simplex) in some individuals.

Eyes

When UV is absorbed by the eyes and eyelids, it can cause keratoconjunctivitis or "welders' flash." This is a very painful condition that feels like grit in the eyes and may make the eyes water and very sensitive to light. The condition usually occurs 6-12 hours after exposure and may last 6-24 hours. The painful injury may make a person unwilling or unable to open his/her eyes during this time period, but most discomfort is gone within 48 hours with no lasting injury. The maximum sensitivity of the eye occurs at a UV wavelength of 270 manometers. Cataracts or clouding of the lens of the eye can occur during high exposures to wavelengths in the range of 295-300 nanometers.

Skin Safety and Health Precautions

Skin burns from high, short-term exposure to UV and skin cancer from long-term exposure can be prevented by covering exposed skin with clothing and protective equipment such as gloves and face shields.* Barrier creams or lotions with sun protection factors (SPF) of 15-18 will also help prevent skin burns.

* Welders' helmets should provide protection for the neck area as well as the face and eyes.

Eyes

Tinted goggles and/or face shields should be worn to prevent burns of the cornea and eyelids. Selection of the appropriate degree of tint should be based on the anticipated wavelength and intensity of the UV source. (see Table 1)

Table 1
Shade No. 3.0: is for glare of reflected sunlight from snow, water, sand, etc.; stray light from cutting and welding, metal pouring and work around furnaces and foundries; and soldering (for goggles or spectacles with side shields worn under helmets in arc welding operations, particularly gas-shielded arc welding operations).
Shade Nos. 4.0 and 5.0: are for light acetylene cutting and welding; light electric spot welding.
Shade Nos. 6.0 and 7.0: are for gas cutting, medium gas welding, and non-gas-shielded arc welding using current values up to 30 amperes.
Shade Nos. 8.0 and 9.0: are for heavy gas cutting and nongas-shielded arc welding and cutting using current values from 30 to 75 amperes.
Shade Nos. 10.0 and 11.0: are for arc welding and cutting using current values from 75 to 200 amperes.
Shade Nos. 12.0 and 13.0: are for arc welding and cutting using current values from 200 to 400 amperes.

Shade No. 14.0: is for arc welding and cutting using current values over 400 amperes (including carbon arc welding and cutting), and for atomic hydrogen welding.

NOTE: ordinary window glass, 1/811 in thickness, is sufficient protection for the eyes and skin against the ultraviolet radiation from ordinary sources such as sunlight. In cases of extremely intense sources of ultraviolet and visible radiation, it is not adequate.

In sunny conditions on water, snow and ice, extra precautions should be taken to protect against reflected sunlight. Sunglasses with side shields should be worn. When applying protective ointments or lotions, special attention should be paid to the nose, lips, underside of the chin, and tops of the ears.

In workplaces, operations such as welding which produce high levels of UV should be performed behind enclosures or barriers to absorb the radiation and shield nearby workers.

UV sources like mercury discharge lamps should be operated only with all safety devices in place and in accordance with manufacturer's instructions.

First Aid Procedures

Skin burns: immediate application of cold (cold water, ice, cold clean cloths) to the affected area will reduce the severity and relieve pain associated with first and second degree burns. Do not apply any burn ointments, creams, or butter to skin burns.

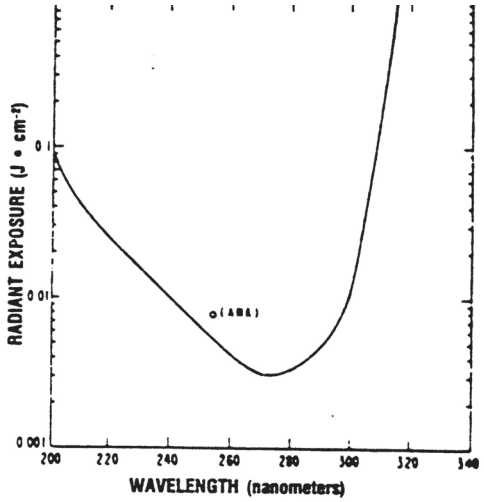
Eyes: place sterile dressings over the eyes of a person suffering from UV burns of the eyes and seek medical attention.

Recommended Exposure Limits[2]

The following section is very technical and is included for the use of safety and health professionals who have the skills and equipment to measure UV levels.

These threshold limit values (TLVS) refer to ultraviolet radiation in the spectral region between 200 and 400 nm and represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect. These values for exposure of the eye or skin apply to ultraviolet radiation from arcs, gas and vapor discharges, flourescent and incandescent sources, and solar radiation, but do not apply to ultraviolet lasers. These values do not apply to ultraviolet radiation exposure of photosensitive individuals or of individuals concomitantly exposed to photosensitizing agents. These values should be used as guides in the control of exposure to continuous sources where the exposure duration shall not be less that 0.1 sec (Figure 1).

Figure 1



These values should be used as guides in the control of exposure to ultraviolet sources and should not be regarded as a fine line between safe and dangerous levels.

Recommended Values

The threshold limit value for occupational exposure to ultraviolet radiation incident upon skin or eye where irradiance values are known and exposure time is controlled are as follows:

1. For the near ultraviolet spectral region (320 to 400 nm), total radiance incident upon the unprotected skin or eye should not exceed 1 mW/cm for periods greated than 110 seconds (approximately 16 minutes) and for exposure times less than 10 seconds should not exceed one J/cm.

2. For the actinic ultraviolet spectral region (200 to 315 nm), radiant exposure incident upon the unprotected skin or eye should not exceed the values given in Table 2 within an 8-hour period.

Table 2
Relative Spectral Effectiveness by Wavelength*

Wavelength (nm)	TLV (mJ/cm^2)	Relative Special Effectiveness S
200	100	0.03
210	40	0.075
220	25	0.12
230	16	0.19
240	10	0.30
250	7	0.43

254	6	0.5
260	4.6	0.65
270	3.0	1.0
280	3.4	0.88
290	4.7	0.64
300	10	0.30
305	50	0.60
310	200	0.015
315	1000	0.003

* See Laser TLVS.

3. To determine the effective irradiance of a broadband source weighted against the peak of the spectral effectiveness curve (270 nm), the following weighting formula should be used:

$$E_{eff} = \Sigma\, E\lambda\, S\lambda\, \Delta\, \lambda$$

where:

E_{eff} = effective irradinace relative to a monochromatic source at 270 nm in W/cm^2 [J/ (s cm^2)]

$E\lambda$ = spectral irradiance in W/(cm nm)

$S\lambda$ = relative spectral effectiveness (unitless)

$\Delta\, \lambda$ = band width in manometers

4. Permissible exposure time in seconds for exposure to actinic ultraviolet radiation incident upon the unprotected skin or eye may be computed by dividing 0.003 J/cm^2 by E_{eff} in W/cm^2. The exposure time may also be determined using Table 3 which provides exposure times corresponding to effective irradiances in μ W/cm^2.

Table 3
Permissible Ultraviolet Exposures

Duration of Exposure Per Day	Effective Irradiance E_{eff} (W/cm^2)
8 hrs	0.1
4 hrs	0.2
2 hrs	0.4

1 hr	0.8
30 min	1.7
15 min	3.3
10 min	5.0
5 min	10.0
1 min	50.0
30 sec	100.0
10 sec	300.0
1 sec	3,000.0
0.5 sec	6,000.0
0.1 sec	30,000.0

5. All the preceding TLVs for ultraviolet energy apply to sources which subtend an angle less than 80 degrees. Sources which subtend a greater angle need to be measured only over an angle of 80 degrees.

Conditioned (tanned) individuals can tolerate skin exposure in excess of the TLV without erythemal effects. However, such conditioning may not protect persons against cancer.

Reference

1. Sunlight and Man. Fitzpatrick et all Eds. University of Tokyo Press, Tokyo, Japan (1974).

2. Threshold Limit Values and Biological Exposures Indices for 1986 - 1987. American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Building D-7, Cincinnati, Ohio 45211-4438.

Attachment E-4

COVID-19 Guidance Document

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INTERCOMPANY MEMO

Date: March 16, 2022 (8th Revision)

Subject: Brice Personnel COVID-19 Pandemic Guidance Memorandum

To: All BES, BEG, BRS Personnel

From: Jamey E Smith, Health, Safety and Environment Manager

The COVID-19 pandemic continues to be an evolving event. Brice is closely following the most current CDC and applicable government guidelines to help mitigate the spread of COVID-19 in order to protect the health and safety of our people and continue business operations. Brice is providing all personnel with the following updated COVID-19 risk guidance table and informational resources. Please be advisedthat COVID-19 requirements may be more restrictive at specific project locations so please refer to the project specific COVID-19 plans in place at those locations.

Risk:	Guidance:
Exposure to COVID-19 on Surfaces and Clothes 	• Do not touch any surface if not needed, use PPE if needed • Clean and disinfect surfaces – Clean high touch surfaces often. When using wet wipes allow additional contact time. Preferably use accelerated hydrogen peroxide – while wearing nitrile gloves • Wash hands with soap and water for 20 seconds – Use hand sanitizer that contains at least 60% or up to 95% of alcohol • Avoid touching face, mouth, nose, and eyes • Cover coughs and sneezes with a tissue • Toss tissue in toilet (preferred) or trash, preferable covered foot operated trash can • Wash clothes after finishing work and clean your PPE often • Do not share PPE
Exposure to COVID-19 in the Air 	• Plan your trip, consider the less crowded transportation method and time of the day • Practice social distancing – six (6) feet from clients and other workers whose health history you do not know and further away from strangers • Wear a mask or face covering

Risk:	Guidance:
Preventing the Spread of COVID-19 	• Wash hands with soap and water for 20 seconds – Wash hands after sneezing, coughing, blowing your nose, or being in a public place – Use hand sanitizer that contains at least 60% or up to 95% of alcohol • Recognize symptoms of CoVid-19 and seek medical attention if you have any symptoms: – Fever (≥100.4°) – Cough – Shortness of Breath – Bluish Lips – Confusion or Inability to Arouse – Persistent Pain or Pressure in the Chest – Diminished smell and taste
Reporting a Potential COVID-19 Exposure- <u>Vaccinated</u> 	• If you learn you have been in close contact with a co-worker, client or member of the public who is COVID-19 positive: – Stop work – Notify your Supervisor and/or Project Manager – ***Watch for symptoms until 10 days*** *after you last had close contact with someone with COVID-19.* – ***Take precaution for 10*** *days e.g wear a mask, avoid crowds, etc.* • Close contact is defined as a) being within approximately 6 feet of a COVID-19 case for a prolonged period of time – Close contact can occur while caring for, living with, visiting, or sharing a healthcare waiting area or room with a COVID-19 case – Having direct contact with infectious secretions of a COVID-19 case (e.g., being coughed on) for 15 or more minutes
Reporting a Potential COVID-19 Exposure- <u>Unvaccinated</u>	• If you learn you have been in close contact with a co-worker, client or member of the public who is COVID-19 positive: – Stop work – Notify your supervisor and/or Project Manager – ***Quarantine for at least 5 days*** – ***Get tested on day 5*** – *Take precaution for 10 days e.g wear a mask, avoid travels, etc.* • Close contact is defined as a) being within approximately 6 feet of a COVID-19 case for a prolonged period of time – Close contact can occur while caring for, living with, visiting, or sharing a healthcare waiting area or room with a COVID-19 case Having direct contact with infectious secretions of a COVID-19 case (e.g., being coughed on) for 15 or more minutes

Risk:	Guidance:
Work Specific Situations/Concerns - <u>vaccinated or unvaccinated</u> 	– If you are working in close contact with other workers or clients and you have tested positive for COVID-19: – ***Self-isolated for a minimum of five (5) days****and end isolation after 5 full days if you are fever-free for 24 hours and your symptoms are improving.* – ***Take precautions 10 days*** *after isolation. E.g., wear a mask, avoid travel, etc.* – ***Notify your supervisor and/or PM and EHS Manager****.* – Do not go to the job site if you have personally tested positive for COVID. – Practice social distancing as much as possible – Practice good hygiene, and if you do not feel the situation is safe, you can execute your stop work authority by having discussions with your supervisor and/or Project Manager • If you are an embedded employee at a client facility: – Practice social distancing as much as possible – Practice good hygiene, and if you do not feel the situation is safe, you can execute your stop work authority by having discussions with your supervisor and/or Project Manager • Close Contact Tracing – Answer the Call when the health care worker calls to help determine close contacts and provide resources to you regarding your symptoms. – Consider workers you have been in close contact with two days prior to your test or symptoms began.
Company/Rented Vehicles Transportation Concerns 	• Follow the cleaning guidance above for frequently touched surfaces • Check with your rental agency before vehicle pick-up to understand their cleaning procedures, and supplement with your own as necessary

Risk:	Guidance:
Lodging Concerns 	• Most hotel/camps have implemented additional cleaning and disinfection procedures – Check with your hotel/camp before check-in to understand their cleaning procedures – Bring a surface cleaner and wipe down frequently touched surfaces such as doorknobs, tv remote, etc.

COVID-19 Information Resources

For the latest information about COVID-19 please refer to the links below. If your questions are not answered through the information provided in these links, please raise them with your immediate supervisor.

External COVID-19 Resources

- World Health Organization Coronavirus Website
- Center for Disease Control
- Answer the call : https://youtu.be/u3dLoBj3YLo

State Specific COVID-19 Resources

- Alaska State Department of Health and Social Services: http://dhss.alaska.gov/dph/Epi/id/Pages/COVID-19/default.aspx
- California State Department of Public Health:https://covid19.ca.gov/
- Colorado State Department of Public Health andEnvironment: https://covid19.colorado.gov/
- Idaho State Department of Health and Welfare:https://coronavirus.idaho.gov/
- Hawaii Occupational Safety and Healthhttps://labor.hawaii.gov/hiosh/
- Washington State Department of Health:https://www.doh.wa.gov/
- Wisconsin Department of Health Services:https://www.dhs.wisconsin.gov/covid- 19/index.htm
- Utah Department of Health:https://coronavirus.utah.gov/

In addition, you may contact HR@bilista.net if you need additional resources.

APPENDIX F
REGULATORY CORRESPONDENCE

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THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

Department of Environmental Conservation

DIVISION OF SPILL PREVENTION AND RESPONSE
Contaminated Sites Program

PO Box 111800
Juneau, Alaska 99811-1800
Main: 907.465.5250
Fax: 907.465.5262

File: 670.38.002
Hazard ID: 3099

June 9, 2022

Sent via electronic mail
Jenna Van Horn
Alaska Army National Guard
PO Box 5169
JBER, AK 99505
Jenna.Vanhorn@alaska.gov

Re: ADEC Response to "Final Work Plan/ UFP-QAPP Remedial Action National Guard Federal Scout Armory Savoonga, Alaska", revised June 2022

Dear Ms. Jenna Van Horn,

The Alaska Department of Environmental Conservation (ADEC) received the revised *"Final Work plan/ UFP-QAPP Remedial Action National Guard Federal Scout Armory Savoonga, Alaska"* report, dated June 2022, and submitted to the department on June 2, 2022. The ADEC's response to comments is enclosed.

The ADEC agrees with all responses to comments on the submitted comment matrix, dated May 25, 2022, with the exception of comment three (3). Please note that the State of Alaska does not distinguish between "porewater" and "groundwater" in regulation. Porewater is water beneath the surface of the ground, within the zone of saturation and is therefore "groundwater", as defined by 18 AAC 75.990 (46). The continued use of the term "porewater" is acceptable so long as it is understood by the Responsible Party that "porewater" will be regulated as groundwater and must meet the same cleanup standards as outlined in 18 AAC 75.345 Table C. A review of the 2009 *Draft Secondary Site Characterization Report*, 2013 *Data Gap Investigation Report*, the 2017 *Final Savoonga Site Characterization Report*, as well as the 2017 *Record of Decision* found only the use of "groundwater" when discussing water found beneath the soil.

Please submit a PDF version of the final work plan to the department with the following changes:

1. On document page 27 - there is a mistype. 11SAVSV001 should be 11SAVSB001. Please update.
2. Site History, document page 14 - references to "Figure 3" should be to "Figure 4". Figure 3 is the Savoonga Conceptual Hydrology Model, while Figure 4 demonstrates Previous Soil and Porewater Sample Locations and Exceedances. Please update.

3. Figure 4 – for MW-04, the value listed for residual range organics (RRO) is incorrect. Diesel range organics (DRO) was detected at 2.9 micrograms per liter (µg/L), and RRO was detected at 1.1 µg/L. Please update.

4. General - there are numerous issues with a reference source not being found. Please update.


Action (RA) activities at the Federal Scout Armory in Savoonga, Alaska during the 2022 field season (**Error! Reference source not found.** and **Error! Reference source not found.**). This Work Plan was prepared by

As a reminder, files may be submitted electronically. Files containing up to 20MB may be emailed to me at CS.Submittals@alaska.gov and files larger than 20 MB up to a limit of 8 GB may be submitted to me through the Alaska ZendTo "drop-off" option at https://drop.state.ak.us/drop/. The CSP prefers electronic only submittals and no longer requires that hard copies be submitted.

You can reach me by phone at (907) 465-5368 or by email at Flannery.ballard@alaska.gov for any questions.

Sincerely,

F. Ballard

Flannery Ballard
Project Manager
Contaminated Sites Program

Enclosure: ADEC Comment Table

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REVIEW

SITE NAME: AKARNG Savoonga FSA
DOCUMENT: Final Work Plan/ UFP-QAPP Remedial Action National Guard Federal Scout Armory
LOCATION: Savoonga, AK
ADEC File No.: 670.38.002
HAZARD ID: 3099

Agency: ADEC			**Date:** 5/23/2022 **ADEC Reviewer:** Flannery Ballard **Phone:** (907) 465-5368	**Date: 5/25/2022**	**Date: 6/9/2022**
Item No.	**PDF Page No.**	**Section**	**ADEC COMMENTS**	**RESPONSIBLE PARTY RESPONSE** **A-Agree D-Disagree**	**ADEC RESPONSE** **A-Agree D-Disagree**
1.	N/A	Cover page	Please add the ADEC File Number and the Hazard ID to the cover page.	A – File number and hazard ID have been added to the cover page.	A
2.	N/A	General	The ADEC's *Field Sampling Guidance* (FSG) was updated in January 2022. There are multiple references to the now outdated version of the FSG throughout the work plan. Please update.	A – ADEC FSG references have been updated throughout and in the Appendix C Field SOPs.	A
3.	N/A	General	ADEC does not recognize the distinction of porewater versus groundwater. All water below the ground surface is considered groundwater. Please revise and use the term "groundwater' instead of "porewater" throughout the work plan. The definition of "groundwater" per 18 AAC 75.990 regulation includes: (A) water in the zone of saturation; or (B) water beneath the surface of the soil, for purposes of evaluating whether the water will act as a transport medium for hazardous substance migration;	D – The term "porewater" is used throughout the site-specific Record of Decision and the approved Record of Decision for Gambell to describe the active seasonally thawed layer found above the permafrost. For consistency, the WP also uses this term. Data gathered from this field effort will be used to assess the applicability of the descriptor "porewater" for the active layer.	D – Water in the zone of saturation/ beneath the surface of the soil is referred to as "groundwater" in the: - 2011 Data Gap Analysis report - 2016 Site Characterization report, - 2017 S*avoonga Federal Scout Readiness Center Record of Decision for Petroleum Contamination* The term "porewater" was not found in the above reports. The continued use of the term "porewater" is acceptable so long as it is understood by the Responsible Party that the State of Alaska does not distinguish between "porewater" and "groundwater" in regulation. "Porewater" will be regulated the same as groundwater, and must meet the same cleanup levels as outlined in Table C

4.	N/A	General	Groundwater throughout Alaska is protected for use as a water supply for drinking, culinary and food processing, agriculture including irrigation and stock watering, aquaculture, and industrial use. Contaminated site cleanup complete determinations are based on groundwater being considered a potential drinking water source unless a specific determination has been made for groundwater at a site per 18 AAC 75.350. There are multiple statements that groundwater is not considered a future drinking water source throughout the work plan. Please revise these statements in the absence of a 350 determination at this site.	A – Until further information is gathered, the supra-permafrost porewater could be considered a potential future drinking water source. Worksheet 10 CSM Affected Media paragraph has been revised to read: Supra-permafrost porewater at the FSA property has been encountered at depths as shallow as 2.5 feet bgs; ~~however, it is not currently or reasonably~~ *in the absence of a determination in accordance with 18 AAC 75.350, supra-permafrost porewater could* ~~be expected to~~ be *considered* a *potential* future source of drinking water in Savoonga. Worksheet 10 CSM Exposure Pathways for Groundwater, Ingestion and Dermal Contact paragraph has been revised to include: *In the absence of a determination in accordance with 18 AAC 75.350, supra-permafrost porewater could be considered a potential future drinking water source, therefore, the ingestion of groundwater is a potentially complete exposure pathway for future receptors.* Worksheet 10 CSM Exposure Pathways for Groundwater, Inhalation of Groundwater Vapor paragraph has been revised to read: Supra-permafrost porewater ~~is not a~~	A

				~~reasonable or expected~~ *could be considered a potential* future drinking water source; therefore, there is ~~no potential~~ *a complete* current or future inhalation of tap water vapor pathway.	
5.	39	Worksheet 15 – Project Action Limits and Laboratory Specific Detection/ Quantitation Limits	*"Analytes not included in the ACLs will be defined by 18 AAC 75 Method Two, Table B1 Soil Cleanup Levels".* Please specify which cleanup level in Table B1 will be used.	A – Note 3 on Worksheet 15 Table 15-1 has been revised to read: [3]PALs are defined by the ACLs or ADEC 18 AAC 75 Method Two *Migration to Groundwater* cleanup levels when there is no ACL in place	A
6.	44	Porewater Investigation	Determining groundwater flow direction is mentioned in Table 11-1, as a Data Quality Objective, but is not mentioned in the narrative. Please discuss whether groundwater flow direction will be assessed during this event.	D – Porewater flow direction and seasonality is listed as an Information Input needed to achieve the Goal of determining if contamination is present in site porewater. The estimated porewater flow direction is already known from previous studies. If sufficient data are collected during this project, porewater flow direction will be calculated to confirm the presumed flow direction.	A – However, previous studies seem to disagree on groundwater flow direction. In the 2011 Data Gap Analysis Report, groundwater flow direction is illustrated in Figure 6-2 as flowing to the northeast, northwest, and southwest. Figure 4 in the 2022 draft work plan indicates that groundwater flows to the northwest. Please attempt to confirm the groundwater flow direction during the 2022 sampling event.
7.	44	Monitoring Well Construction	Please expand this section to include the temporary monitoring well installation methodology. BE-SOP-22, found in Appendix C outlines many ways to install a monitoring well, but does not specify as to how monitoring wells will be installed at this site. Are you planning on excavating or using direct push technology to install the monitoring wells? If drilling, are you planning on screening and	A – The first sentence of Monitoring Well Construction has been revised to read: Four temporary monitoring wells will be *excavation* installed*, in accordance with ADEC Monitoring Well Guidance (ADEC 2013),* to the east and south of the source area.	A

			analyzing any of the soil borings? Please include this information in the narrative.		
8.	44	Monitoring Well Construction	Please include the planned depth of the groundwater monitoring wells. Please include the well screen intervals and the length of screens to be used.	A – Monitoring Well Construction section has been revised to read: Temporary monitoring wells will be constructed with 5 feet of 1-inch PVC well screen and 1-inch PVC risers. Silica sand will be placed in the well annulus around the well screen and at least 1 foot above the well screen. *Monitoring wells are expected to be installed between 2 and 6 feet bgs and will be screened to capture the supra-permafrost porewater layer, typically found between 2 and 4 feet bgs.*	A
9.	44	Monitoring Well Construction	It does appear that contamination to groundwater will be completely delineated by the proposed temporary monitoring wells. Future delineation efforts may be required.	D – As stated in Worksheet 11 Data Quality Objectives, determining presence/absence of contamination in porewater through installation of wells east of the source area is a project objective. To this end, four wells are planned for east of the source area and one well downgradient to the northwest. Prior investigations have shown that porewater is clean south and west of the source area (MW-01 and MW-05, Figure 4).	A – the location of the monitoring wells cover the scope of this investigation.
10.	45	Monitoring Well Development	According to the FSG, the ADEC only requires the purging of one volume of the well casing's volume to be considered developed.	A – Worksheet 17, Monitoring Well Development paragraph states: Well installation and development will be conducted in accordance with the ADEC Monitoring Well Guidance (ADEC 2013) and the ADEC	A

				Field Sampling Guidance (ADEC 2022). SOP-22 in Appendix C for MW installation and development will also be updated.	
11.	46	Liquid Waste	According to the FSG, Section 14 – Investigation Derived Waste, if sampling of the effluent is not proposed, calculations of GAC breakthrough should be provided to the Contaminated Sites Program for review and approval before onsite disposal of purge water. Are you planning on sampling the effluent? If not, please provide breakthrough calculations for the GAC filtration system.	A – The following text has been added to the Liquid Waste section to describe GAC breakthrough calculations: *One 5-gallon GAC unit filled with commercial GAC will be used. According to commercial GAC specifications and published contaminant data, the GAC unit is calculated to treat 4,090 gallons of water with Naphthalene concentrations up to 150 mg/L to below regulatory limits, at an estimated flow rate of 5 gallons per minute. Naphthalene was used as a representative compound for the other petroleum compounds that will be treated during project activities. Compounds anticipated during project activities such as hydrocarbons with high molecular weights are considered readily adsorbed organics. Additionally, it is expected that less than 25 gallons of water will be treated throughout the project activities, so the GAC has a significantly higher capacity than needed and no breakthrough is expected. Treated water volume will be tracked to ensure these volumes are not exceeded.*	A

12.	51	Table 18-1, Sample Locations	In the Sample Depth column, first row, please clarify whether "field observations" includes PID readings?	A – Text has been revised to read: Collect primary analytical sample from most contaminated locations on sidewalls and base of excavation based on field observations *(elevated PID screening results and visual and/or olfactory observations).*	A
13.		Appendix D – Conceptual Site Model	There are multiple inconsistencies between the Conceptual Site Model (CSM) section in the narrative, and the attached Human Health CSM Scoping Form. These include, but are not limited to: Question 1, Sources. Please include "other – heating oil fuel lines" as an additional source, as outlined in the second paragraph of Site History, page 14. Question 1, Impacted Media. "Groundwater" should be selected as an impacted media. Question 1, Receptors. "Subsistence consumers" should be selected as an impacted receptor. The Human Health CSM Graphic Form is not complete. Please complete these forms so that they are consistent with the CSM narrative in the report.	A – ASTs are marked as a potential source. Heating oil fuel lines are added to "Other" as a potential source. A – Groundwater is selected as an impacted media, as supra-permafrost porewater at the Savoonga FSA is being evaluated relative to the "groundwater" exposure pathways. A – Subsistence consumers are selected as an impacted receptor. CSM Scoping Form and Graphic have been revised to align with the Human Health CSM narrative presented in Worksheet 10.	A
14.			End of comments.		