UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION 8

IN THE MATTER OF:

Idaho Pole Co. Superfund Site
Bozeman, Montana

Idaho Pole Company,

Respondent

Proceeding Under Sections 104, 106(a), 107 and 122 of the Comprehensive Environmental Response, Compensation, and Liability Act

CERCLA Docket No. ____

CERCLA-08-2022-0008

ADMINISTRATIVE SETTLEMENT AGREEMENT AND ORDER ON CONSENT FOR IN SITU AMENDMENTS IN SUPPORT OF FOCUSED FEASIBILITY STUDY

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I. JURISDICTION AND GENERAL PROVISIONS

1. This Administrative Settlement Agreement and Order on Consent ("Settlement") is entered into voluntarily by the United States Environmental Protection Agency ("EPA") and the Idaho Pole Company ("Respondent"). This Settlement provides for the performance of In Situ Amendments by Respondent and the payment by Respondent of certain response costs incurred by the United States at or in connection with the Work.

2. This Settlement is issued under the authority vested in the President of the United States by sections 104, 106(a), 107, and 122 of the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"). EPA is proceeding under the CERCLA authority vested in the President of the United States and delegated to the Administrator of EPA and further delegated to the undersigned Regional official.

3. EPA has notified the State of Montana ("State") of this action pursuant to section 106(a) of CERCLA.

4. The Parties recognize that this Settlement has been negotiated in good faith and that the actions undertaken by Respondent in accordance with this Settlement do not constitute an admission of any liability. Respondent does not admit, and retains the right to controvert in any subsequent proceedings other than proceedings to implement or enforce this Settlement, the validity of the findings of facts, and conclusions of law and determinations in Sections IV (Findings of Fact) and V (Conclusions of Law and Determinations) of this Settlement. Respondent agrees to comply with and be bound by the terms of this Settlement and agrees not to contest the basis or validity of this Settlement or its terms.

5. As described below, on August 26, 1993, EPA issued an Administrative Order ("UAO") for Remedial Design ("RD")/Remedial Action ("RA") requiring that Respondent, among others, implement the RD/RA process. EPA will terminate the UAO with completion of the following: EPA issuance of written notice to Respondent of the Effective Date of the fully executed Settlement.

II. PARTIES BOUND

6. This Settlement is binding upon EPA and upon Respondent and its successors. Unless EPA otherwise consents, (a) any change in ownership or corporate or other legal status of any Respondent, including any transfer of assets, or (b) any Transfer of the Site or any portion thereof, does not alter any of Respondent's obligations under this Settlement. EPA may consent, in writing, by referencing this Paragraph of the Settlement and describing the obligations to be transferred or otherwise altered.

7. Respondent must provide notice of this Settlement to officers, directors, employees, agents, contractors, subcontractors, or any person representing Respondent with respect to the Site or the Work. Respondent is responsible for ensuring that such parties act in accordance with the terms of this Settlement.

III. DEFINITIONS

8. Terms not otherwise defined in this Settlement have the meanings assigned in CERCLA or in regulations promulgated under CERCLA. Whenever the terms set forth below are used in this Settlement, the following definitions apply:

"2016 Institutional Controls" means the Restated and Amended Declaration of Institutional Controls on Real Property recorded on August 15, 2016, in Gallatin County, Montana, by Idaho Pole Company (document number 2554371).

"CERCLA" means the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601-9675.

"Day" or "day" means a calendar day. In computing any period of time under this Settlement, the day of the event that triggers the period is not counted and, where the last day is not a working day, the period runs until the close of business of the next working day. "Working Day" means any day other than a Saturday, Sunday, or federal or State holiday.

"Effective Date" means the effective date of this Settlement as provided in Section XXV.

"EPA" means the United States Environmental Protection Agency.

"Fund" means the Hazardous Substance Superfund established under section 9507 of the Internal Revenue Code, 26 I.R.C. § 9507.

"Future Response Costs " means all costs (including direct, indirect, payroll, contractor, travel, and laboratory costs) that the United States: (a) pays between October 1, 2021 and the Effective Date; and (b) pays after the Effective Date in supporting, developing, implementing, overseeing, or enforcing this Settlement, including: (i) in developing, reviewing and approving deliverables generated under this Settlement; (ii) in overseeing Respondent's performance of the Work; (iii) in assisting or taking action to obtain access under Paragraph 51; (iv) in taking action under Paragraph 55 (Access to Financial Assurance); (v) in taking response action described in Paragraph 68 because of Respondent's failure to take emergency action under Paragraph 39; (vi) in implementing a Work Takeover under Paragraph 47; (vii) community involvement; and (viii) in enforcing this Settlement, including all costs paid under Section XIV (Dispute Resolution) and all litigation costs.

"Including" or "including" means "including but not limited to."

"Interest" means interest at the rate specified for interest on investments of the Fund, as provided under section 107(a) of CERCLA, compounded annually on October 1 of each year. The applicable rate of interest will be the rate in effect at the time the interest accrues. The rate of interest is subject to change on October 1 of each year. As of the date EPA signs this Settlement, rates are available online at https://www.epa.gov/superfund/superfund-interest-rates.

"NCP" means the National Oil and Hazardous Substances Pollution Contingency Plan (also called the "National Contingency Plan") promulgated pursuant to section 105 of CERCLA, codified at 40 C.F.R. Part 300, and any amendments thereto.

"Paragraph" means a portion of this Settlement identified by an Arabic numeral or an upper- or lower-case letter.

"Parties" means EPA and Respondent.

"RCRA" means the Solid Waste Disposal Act, as amended, 42 U.S.C. §§ 6901-6992k (also known as the Resource Conservation and Recovery Act).

"In Situ Amendments" means the Work required under the Work Plan.

"Respondent" means Idaho Pole Company, a Washington corporation.

"Section" means a portion of this Settlement identified by a Roman numeral.

"Settlement" means this Administrative Settlement Agreement and Order on Consent, all appendices attached hereto (listed in Section XXI), and all deliverables approved under and incorporated into this Settlement. If there is a conflict between a provision in Sections I through XXV and a provision in any appendix or deliverable, the provision in Sections I through XXV controls.

"Site" means the Idaho Pole Co. Superfund Site, encompassing approximately 87 acres, located at Cedar Street, Bozeman, Montana 59715 and depicted generally on the map attached as Appendix A.

"Special Account" means the Idaho Pole Co. Superfund Site Special Account. The Special Account is EPA Hazardous Substance Superfund Special Account Number 0862, established for the Site by EPA pursuant to Section 122(b)(3) of CERCLA, 42 U.S.C. § 9622(b)(3), and Remedial Design/Remedial Action Unilateral Administrative Order (RD/RA UAO) EPA Docket No. CERCLA VIII-93-26.

"State" means the State of Montana.

"Transfer" means to sell, assign, convey, lease, mortgage, or grant a security interest in, or where used as a noun, a sale, assignment, conveyance, or other disposition of any interest by operation of law or otherwise.

"United States" means the United States of America and each department, agency, and instrumentality of the United States, including EPA and Settling Federal Agencies.

"Waste Material" means (a) any "hazardous substance" under section 101(14) of CERCLA; (b) any pollutant or contaminant under section 101(33) of CERCLA; and (c) any "solid waste" under section 1004(27) of RCRA.

"Work" means all obligations of Respondent under Sections VII (Coordination and Supervision) through XI (Indemnification and Insurance).

"Work Plan" means the Work Plan, attached as Appendix B, that describes the activities Respondent must perform to implement and monitor the In Situ Amendments, and any modifications made thereto in accordance with this Settlement.

"UAO" means the Administrative Order for Remedial Design/Remedial Action, EPA Docket No. CERCLA-VIII-93-26 (1993).

IV. FINDINGS OF FACT

9. The 87-acre Site is located in the City of Bozeman, Gallatin County, Montana. The Site is located roughly one mile from the center of Bozeman.

10. Between the late 1800s and early 1940s, Burlington Northern Railway Company ("BNRC"), the predecessor company to Burlington Northern Santa Fe Railway Company ("BNSF"), operated a five-stall roundhouse south of Cedar Street and east of L Street. In 1945, Respondent began operating the Idaho Pole Co. wood treating facility, using creosote to preserve wood. In 1952, the company switched to pentachlorophenol mixed with a heated carrier oil (similar to fuel oil such as diesel) for the wood treating solution. Site processes included pole treatment in butt vats with the later addition of pressurized heated retort equipment in the area south of Cedar Street. Treated poles were stacked for drying and shipment in the area. Pole treatment processes included pole peeling with a bark-fill area for wood waste north of Cedar Street. In 1975, a pressurized heated retort was added for treating full-length poles. In the early 1980s, the pole-length vats were removed. There was also a drying area where treated poles were stored prior to shipment. Respondent continued wood treating with a pressurized heated retort and butt-dipping vat until September 1997, when the company ceased wood-treating operations.

11. The contaminants of concern are pentachlorophenol ("PCP"), polycyclic aromatic hydrocarbons ("PAHs"), polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans ("dioxins/furans").

12. In 1984, EPA proposed the facility for listing on the National Priorities List ("NPL"). On June 10, 1986, EPA finalized the NPL listing.

13. In 1992, EPA selected the remedy in a Record of Decision ("ROD"). EPA subsequently clarified the remedy in 1996 and 1998 Explanations of Significant Differences.

14. The selected remedy in the ROD, as amended, includes components for soil, sediment and groundwater treatment, as well as institutional controls. All components of the remedy are construction complete, including groundwater.

15. Soil and sediment components of the remedy selected in the ROD include excavation and surface land biological treatment of 24,000 cubic yards of impacted materials.

Treated soils have been placed in an on-site 4.5 acre repository referred to as the Treated Soils Area ("TSA").

16. Groundwater components of the remedy selected in the ROD include groundwater extraction wells, biological treatment, and return of treated water to the aquifer to enhance in-situ biological degradation and to control potential migration of contaminants. Respondent conducted treatment of groundwater at the Site from 1997 through 2016 by the groundwater recovery system (GRS). Over 624 million gallons of groundwater were treated by the GRS with no reported exceedances of discharge limits. Approximately 60 pounds of total PAH compounds and 290 pounds of PCP were removed by the GRS during operations.

17. Based on pilot studies conducted in 2015 and 2016, EPA approved the decommissioning of the GRS. The GRS was dismantled in 2018.

18. After EPA signed the ROD, the Agency initiated negotiations with potentially responsible parties, Respondent and BNRC (now known as BNSF) (collectively, the "PRPs"), for implementation of the selected remedy, including remedial design ("RD") and remedial action ("RA"). These negotiations were unsuccessful.

19. On August 26, 1993, EPA issued an Administrative Order for RD/RA requiring that the PRPs implement the RD/RA process ("UAO"). EPA became the lead oversight agency for the PRP-lead RD/RA at that time, with DEQ as the support agency.

20. The PRPs implemented the original selected remedy and paid EPA oversights costs under a UAO. Respondent is the work party, and BNSF provides financial and technical support under the UAO.

21. On or about November 2, 2001, the Montana Department of Natural Resources and Conservation designated a Controlled Groundwater Use Area by Final Order in the Matter of Petition No. 41-H-114172 to the Department of Natural Resources and Conservation for Designation of a Controlled Groundwater Area ("CGA") in Gallatin County. This CGA restricts use of groundwater beneath the Site for any purpose, except as provided in the remedial action or as otherwise authorized by EPA and the Montana Department of Environmental Quality.

22. On or about August 15, 2016, Respondent recorded the 2016 Institutional Controls for seven parcels, including the four parcels that constitute the Property.

23. On September 9, 2019, EPA amended the Statement of Work attached to the UAO to require screening of technologies and process options and development of remedial alternatives to address the remaining groundwater contamination at the Site. Respondent submitted a Focused Feasibility Study to the Agencies on November 10, 2021, and the EPA is currently reviewing the Focused Feasibility Study. The purpose of the Focused Feasibility Study is to develop and evaluate remedial alternatives that address the remaining contaminants in groundwater. If a modification to the remedy is necessary, EPA will record the modification in a decision document.

24. Respondent will implement the In Situ Amendments as an integral part of the Focused Feasibility Study, pursuant to the Work Plan.

25. In 2020, EPA partially deleted portions of the Site from the NPL where EPA determined no further action is needed to protect human health and the environment. Specifically, the deleted areas are comprised of surface and unsaturated subsurface soils. The remaining areas, including the groundwater encompassed by the CGA remain on the NPL).

V. CONCLUSIONS OF LAW AND DETERMINATIONS

26. Based on the Findings of Fact in Section IV, and the administrative record, EPA has determined that:

a. The Site is a "facility" as defined by section 101(9) of CERCLA.

b. The contamination found at the Site, as identified in the Findings of Fact above, includes "hazardous substance(s)" as defined by section 101(14) of CERCLA.

c. Respondent is a "person" as defined by section 101(21) of CERCLA.

d. Respondent is a potentially responsible party under section 107(a) of CERCLA, 42 U.S.C. § 9607(a). Respondent is the "owner" and/or "operator" of the facility, as defined by section 101(20) of CERCLA and within the meaning of section 107(a)(1) of CERCLA.

e. The conditions described in Section IV (Findings of Fact) constitute an actual or threatened "release" of a hazardous substance from the facility as defined by section 101(22) of CERCLA.

f. The In Situ Amendments are necessary to protect the public health, welfare, or the environment and, if carried out in compliance with the terms of this Settlement, will be deemed to be consistent with the NCP, as provided in section 300.700(c)(3)(ii) of the NCP.

VI. ORDER AND AGREEMENT

27. Based upon the Findings of Fact, Conclusions of Law, and Determinations set forth above, and the administrative record, it is hereby Ordered and Agreed as follows:

VII. COORDINATION AND SUPERVISION

28. **Respondent's Project Coordinator**

a. Respondent has proposed, and EPA has not disapproved, the following Project Coordinator: Les Lonning and Heidi Kaiser. Respondent's Project Coordinator will be responsible for administration of all actions by Respondent required by this Settlement.

b. Respondent's Project Coordinator must have sufficient technical expertise to coordinate the Work. To the greatest extent possible, the Project Coordinator will be present on Site or readily available during Site work.

c. Notice or communication relating to this Settlement from EPA to Respondent's Project Coordinator constitutes notice or communication to Respondent.

d. Respondent may change its Project Coordinator by following the procedures under Paragraph 29.

29. Procedures for Notice and Disapproval

a. Respondent will notify EPA of the names, titles, contact information, and qualifications of any contractors or subcontractors retained to perform the Work at least 30 days prior to commencement of such Work.

b. EPA may issue notices of disapproval regarding any proposed Project Coordinator, contractor, or subcontractor, as applicable. If EPA issues a notice of disapproval, Respondent will, within 30 days, submit to EPA a list of supplemental proposed Project Coordinators, contractors, or subcontractors, as applicable, including a description of the qualifications of each.

c. EPA may disapprove the proposed Project Coordinator, contractor, or subcontractor, based on objective assessment criteria (e.g., experience, capacity, technical expertise), if they have a conflict of interest regarding the project, or any combination of these factors.

30. **EPA Remedial Project Manager**. EPA designates Roger Hoogerheide of the Superfund and Emergency Management Division, Region 8, as its Remedial Project Manager ("RPM"). The RPM has the authorities described in the NCP, including oversight of Respondent's implementation of the Work, authority to halt, conduct, or direct any Work, or to direct any other response action undertaken at the Site. The RPM's absence from the Site is not a cause for stoppage of work. EPA may change its RPM and will notify Respondent at least 30 days prior to any such change, except in cases of emergency as deemed by EPA in its sole and unreviewable discretion.

VIII. PERFORMANCE OF THE WORK

31. Respondent must perform all actions necessary to implement the Work in the Work Plan in accordance with this Settlement, including all EPA-approved, conditionally approved, or modified deliverables as required by this Settlement. The Work Plan includes the following four components ("Components"):

1. In Situ Amendments

2. Seven Years of Performance Monitoring through 2030 Five-Year Review

3. In Situ Amendments (Contingency – as determined necessary by EPA)

4. Five Years of Performance Monitoring through 2035 Five-Year Review (Contingency – as determined necessary by EPA)

32. For any regulation or guidance referenced in the Settlement, the reference will be read to include any subsequent modification, amendment, or replacement of such regulation or guidance. Such modifications, amendments, or replacements apply to the Work only after Respondent receives notification from EPA of the modification, amendment, or replacement.

33. **Work Plans.** The Work, as described in Paragraph 31, is divided into Components. The attached approved Work Plan addresses Component 1 and performance monitoring to be performed quarterly for nine months under Component 2. Within 15 days after the third quarter analytical data has been validated, Respondent must submit a Component 2 Interim Report that evaluates the first three quarters of performance monitoring, for EPA's acceptance. Within 60 days after EPA's acceptance of the Component 2 Interim Report, Respondent must submit a Revised Work Plan for approval in accordance with Paragraph 36 (Deliverables: Specifications and Approval) to address any performance monitoring modifications necessary to complete Component 2 performance monitoring. Respondent will be required to continue monitoring at the frequency required under the Work Plan until the Revised Work Plan is approved by EPA. Should EPA determine Components 3 and 4 are necessary, EPA will notify Respondent that those work plans are necessary.

34. **Health and Safety Plan.** Within 30 days after the Effective Date, Respondent will submit for EPA review and acceptance a plan that describes all activities to be performed to protect on-site personnel and area residents from physical, chemical, and all other hazards related to performance of Work under this Settlement, as described in the Work Plan.

35. **Quality Assurance, Sampling, and Data Analysis**

a. Respondent must use quality assurance, quality control, and other technical activities and chain of custody procedures for all samples consistent with EPA's *Environmental Information Quality Policy,* CIO 2105.1) (Mar. 2021) at https://www.epa.gov/irmpoli8/environmental-information-quality-policy, the most recent version of Quality Management Systems for Environmental Information and Technology Programs – Requirements with Guidance for Use, ASQ/ANSI E-4 (Feb. 2014), and *EPA Requirements for Quality Assurance Project Plans*, EPA QA/G-5 (EPA/240/B-01/02) (March 2001) at https://www.epa.gov/quality/epa-qar-5-epa-requirements-quality-assurance-project-plans.

b. Respondent will ensure that EPA personnel and its authorized representatives are allowed access at reasonable times to laboratories used by Respondent in implementing this Settlement. In addition, Respondent will ensure that such laboratories analyze

all samples submitted by EPA pursuant to the Quality Assurance Project Plan for quality assurance monitoring, and that sampling and field activities are conducted in accordance with the *EPA QA Field Activities Procedure*, CIO 2105-P-02.1 (9/23/2014) available at http://www.epa.gov/irmpoli8/epa-qa-field-activities-procedures. Respondent will ensure that the laboratories it utilizes for the analysis of samples taken pursuant to this Settlement meet the competency requirements set forth in the *Policy to Assure Competency of Laboratories, Field Sampling, and Other Organizations Generating Environmental Measurement Data under Agency-Funded Acquisitions* (Directive No. FEM-2011-01) (Nov. 2016) available at http://www.epa.gov/measurements/documents-about-measurement-competency-under-acquisition-agreements and that the laboratories perform all analyses according to EPA-accepted methods. Accepted EPA methods are documented in the EPA's Contract Laboratory Program (http://www.epa.gov/clp), SW 846 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (https://www.epa.gov/hw-sw846), *Standard Methods for the Examination of Water and Wastewater* (http://www.standardmethods.org/), 40 C.F.R. Part 136, *Air Toxics - Monitoring Methods* (http://www3.epa.gov/ttnamti1/airtox.html).

c. Upon request, Respondent must provide split or duplicate samples to EPA or its authorized representatives. Respondent must notify EPA not less than 7 days prior to any sample collection activity unless shorter notice is agreed to by EPA. In addition, EPA has the right to take any additional samples that EPA deems necessary. Upon request, EPA may provide to Respondent split and/or duplicate samples in connection with EPA's oversight sampling.

d. Respondent must submit to EPA all sampling and test results and other data obtained or generated by or on behalf of Respondent or in connection with the implementation of this Settlement.

36. **Deliverables: Specifications and Approval**

a. **General Requirements for Deliverables.** Respondent will submit all deliverables to EPA in electronic form, unless otherwise specified by the RPM.

b. **Technical Specifications for Deliverables.** Sampling and monitoring data should be submitted in standard Regional Electronic Data Deliverable ("EDD") format. Other delivery methods may be allowed if electronic direct submission presents a significant burden or as technology changes.

c. **Approval of Deliverables**. After review of the Work Plan, Revised Work Plan, and any other deliverable required to be submitted for EPA approval under the Settlement, EPA will: (i) approve, in whole or in part, the deliverable; (ii) approve the submission upon specified conditions or required revisions to the deliverable; (iii) disapprove, in whole or in part, the deliverable; or (iv) any combination of the foregoing. If EPA requires revisions, EPA will provide a deadline for the resubmission, and Respondent must submit the revised deliverable by the required deadline. Once approved or approved with conditions, Respondent must implement the Work Plan, Revised Work Plan, or other deliverable in accordance with the EPA-approved schedule. Upon approval, or subsequent modification, by EPA of any deliverable, or any portion thereof: (1) such deliverable, or portion thereof, and any subsequent modifications, will be

incorporated into and enforceable under the Settlement; and (2) Respondent must take any action required by such deliverable, or portion thereof. Respondent will perform the Work in conformance with the terms of this Settlement.

37. **Off-Site Shipments**

a. Respondent may ship hazardous substances, pollutants and contaminants from the Site to an off-Site facility only if it complies with section 121(d)(3) of CERCLA, 42 U.S.C. § 9621(d)(3), and 40 C.F.R. § 300.440. Respondent will be deemed to be in compliance with section 121(d)(3) of CERCLA and 40 C.F.R. § 300.440 regarding a shipment if Respondent obtains a prior determination from EPA that the proposed receiving facility for such shipment is acceptable under the criteria of 40 C.F.R. § 300.440(b).

b. Respondent may ship Waste Material from the Site to an out-of-state waste management facility only if, prior to any shipment, it provides written notice to the appropriate state environmental official in the receiving facility's state and to the RPM. The written notice must include the following information, if available: (i) the name and location of the receiving facility; (ii) the type and quantity of Waste Material to be shipped; (iii) the schedule for the shipment; and (iv) the method of transportation. Respondent also must notify the state environmental official referenced above and the RPM of any major changes in the shipment plan, such as a decision to ship the Waste Material to a different out-of-state facility. Respondent must provide the written notice after the award of the contract for the In Situ Amendments and before the Waste Material is shipped.

c. Respondent may ship Investigation Derived Waste (IDW) from the Site to an off-Site facility only if they comply with section 121(d)(3) of CERCLA, 40 C.F.R. § 300.440, EPA's "Guide to Management of Investigation Derived Waste," OSWER 9345.3-03FS (Jan. 1992), and any IDW-specific requirements contained in the Work Plan. Wastes shipped off-Site to a laboratory for characterization, and RCRA hazardous wastes that meet the requirements for an exemption from RCRA under 40 C.F.R. § 261.4(e) shipped off-Site for treatability studies, are not subject to 40 C.F.R. § 300.440.

38. **Permits**

a. As provided in section 121(e) of CERCLA, and Section 300.400(e) of the NCP, no permit is required for any portion of the Work conducted entirely on-site (*i.e.*, within the areal extent of contamination or in very close proximity to the contamination and necessary for implementation of the Work). Where any portion of the Work that is not on-site requires a federal or state permit or approval, Respondent will submit timely and complete applications and take all other actions necessary to obtain all such permits or approvals.

b. Respondent may seek relief under the provisions of Section 0 (Force Majeure) of the Settlement for any delay in the performance of the Work resulting from a failure to obtain, or a delay in obtaining, any permit or approval referenced in Paragraph 38.a and required for the Work, provided that they have submitted timely and complete applications and taken all other actions necessary to obtain all such permits or approvals.

c. Nothing in the Settlement constitutes a permit issued under any federal or state statute or regulation.

39. **Emergency Response.** If any event occurs during performance of the Work that causes or threatens to cause a release of Waste Material on, at, or from the Site and that either constitutes an emergency situation or that may present an immediate threat to public health or welfare or the environment, Respondent must: (a) immediately take all appropriate action to prevent, abate, or minimize such release or threat of release; (b) immediately notify the RPM or, in the event of their unavailability, the Regional Duty Officer at (800) 424-8802 of the incident or Site conditions; and (c) take such actions in consultation with the RPM or authorized EPA officer and in accordance with all applicable provisions of this Settlement, including, the Health and Safety Plan, and any other applicable deliverable approved by EPA.

40. **Release Reporting**. Upon the occurrence of any event during performance of the Work that Respondent is required to report under section 103 of CERCLA or section 304 of the Emergency Planning and Community Right-to-Know Act (EPCRA), 42 U.S.C. § 11004, Respondent must immediately orally notify the RPM or, in the event of their unavailability, the Regional Duty Officer at (800) 424-8802, and the National Response Center at (800) 424-8802. Respondent must also submit a written report to EPA within seven days after the onset of such event, (a) describing the event, and (b) all measures taken and to be taken: (i) to mitigate any release or threat of release, (ii) to mitigate any endangerment caused or threatened by the release; (iii) to prevent the reoccurrence of any such a release or threat of release. The reporting requirements under this Paragraph are in addition to the reporting required by CERCLA § 103 and 111(g) or EPCRA § 304.

41. **Progress Reports/Construction Completion Report**.

a. Commencing upon EPA's approval of the Work Plan and until issuance of Notice of Completion of Work under Paragraph 44, Respondent must submit written progress reports to EPA on a quarterly basis for the first nine months after in situ amendments have been completed and at the frequency described in the EPA-approved Revised Work Plan after that or as otherwise directed in writing by the RPM. These reports must describe all significant developments during the preceding reporting period, including the actions performed and any problems encountered, analytical data received during the reporting period, and the developments anticipated during the next reporting period, including a schedule of actions to be performed, anticipated problems, and planned resolutions of past or anticipated problems.

b. Upon completion of Component 1, Respondent will submit for EPA's review and approval a construction report regarding the completion of Component 1 of the Work. Upon completion of Component 3, if necessary, Respondent will submit for EPA's review and approval a construction report regarding the completion of Component 3 of the Work. Each such submission must be titled, "Construction Completion Report."

42. **Additional Response Action**. If EPA determines that additional response actions not included in the In Situ Amendments Work Plan or other approved plan(s) are necessary to

protect public health, welfare, or the environment, EPA will notify Respondent of that determination. Respondent also may request modification of the approved In Situ Amendments Work Plan or other deliverables. Respondent must, within 30 days thereafter, submit a revised In Situ Amendments Work Plan and other deliverables as necessary to EPA for approval. Respondent must implement the revised In Situ Amendments Work Plan and any other deliverables upon EPA's approval in accordance with the procedures of Paragraph 36 in accordance with the approved provisions and schedule. This Paragraph does not limit the RPM's authority to make oral modifications to any plan or schedule pursuant to Section XXII (Modifications).

43. **Final Report.**

a. Within 60 days after completion of all Work required by this Settlement other than the continuing obligations listed in Paragraph 45.a, Respondent must submit for EPA review and approval a final report regarding the Work. The final report must (a) summarize the actions taken to comply with this Settlement; (b) conform to the requirements of section 300.165 of the NCP ("OSC Reports"); (c) list the quantities and types of waste materials removed off-Site or handled on-Site; (d) describe the removal and disposal options considered for those materials; (e) identify the ultimate destination(s) of those materials; (f) include the analytical results of all sampling and analyses performed; and (g) include all relevant documentation generated during the Work (e.g., manifests, invoices, bills, contracts, and permits) and an estimate of the total costs incurred to complete the Work.

b. The final report must also include the following certification signed by a responsible corporate official of a Respondent or Respondent's Project Coordinator: "I certify under penalty of perjury that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

44. **Periodic Review**. Respondent must conduct studies and investigations to support EPA's reviews under section 121(c) of CERCLA, 42 U.S.C. § 9621(c), and applicable regulations, of whether the Site is protective of human health and the environment.

45. **Notice of Completion of Work**

a. If after reviewing the Final Report under Paragraph 43, EPA determines that all Work, other than the continuing obligations, has been fully performed in accordance with this Settlement, EPA will provide notice to Respondent. Notice of completion of work does not affect the following continuing obligations:

(1) Post Removal Site Controls;

(2) Payment of Future Response Costs; and

(3) Record Retention.

b. If EPA determines that any Work other than the continuing obligations has not been completed in accordance with this Settlement EPA will notify Respondent including a list of deficiencies. Respondent must promptly correct all such deficiencies. Respondent will submit a modified Final Report upon completion of the deficiencies.

46. **Compliance with Applicable Law**. Nothing in this Settlement affects Respondent's obligations to comply with all applicable state and federal laws and regulations, except as provided in section 121(e) of CERCLA, and 40 C.F.R. §§ 300.400(e) and 300.415(j). In accordance with 40 C.F.R. § 300.415(j), all on-site actions required pursuant to this Settlement must, to the extent practicable, as determined by EPA, considering the exigencies of the situation, attain applicable or relevant and appropriate requirements (ARARs) under federal environmental or state environmental or facility siting laws. Respondent will include ARARs selected by EPA based on the Focused Feasibility Study. The ARARs are included as Appendix C. The activities conducted in accordance with this Settlement, if approved by EPA, will be deemed to be consistent with the NCP as provided under section 300.700(c)(3)(ii).

47. **Work Takeover**

a. If EPA determines that Respondent: (1) has ceased implementation of any portion of the Work; (2) is seriously or repeatedly deficient or late in performing the Work; or (3) is implementing the Work in a manner that may cause an endangerment to human health or the environment, EPA may issue a notice of Work Takeover to Respondent, including a description of the grounds for the notice and a period of time ("Remedy Period") within which Respondent must remedy the circumstances giving rise to the notice. The Remedy Period will be 20 days, unless EPA determines in its unreviewable discretion that there may be an endangerment, in which case the Remedy Period will be 10 days.

b. If, by the end of the Remedy Period, Respondent does not remedy to EPA's satisfaction the circumstances giving rise to the notice of Work Takeover, EPA may notify Respondent and, as EPA deems necessary, commence a Work Takeover.

c. EPA may conduct the Work Takeover during the pendency of any dispute under Section XIV but will terminate the Work Takeover if and when: (i) Respondent remedies, to EPA's satisfaction, the circumstances giving rise to the notice of Work Takeover; or (ii) upon the issuance of a final determination under Section XIV that EPA is required to terminate the Work Takeover.

IX. PROPERTY REQUIREMENTS

48. If the Site, or any other property where access is needed to implement this Settlement, is owned or controlled by Respondent, Respondent will, commencing on the

Effective Date, provide EPA, the State, and their representatives, including contractors, with access at all reasonable times to the Site, or such other property, for the purpose of conducting any activity related to this Settlement. Where any action under this Settlement is to be performed in areas owned or controlled by someone other than Respondent, Respondent will use best efforts to obtain all necessary agreements for access, enforceable by Respondent and EPA, within 30 days after the Effective Date, or as otherwise specified in writing by the RPM.

49. As used in this Section, "best efforts" means the efforts that a reasonable person in the position of Respondent would use to achieve the goal in a timely manner, including the cost of employing professional assistance and the payment of reasonable sums of money to secure access or use restriction agreements, as required by this Section. If Respondent cannot accomplish what is required through "best efforts" in a timely manner, it will notify EPA, and include a description of the steps taken to achieve the requirements. If EPA deems it appropriate, it may assist Respondent, or take independent action, to obtain such access and/or use restrictions.

50. Respondent, for any Site property that it owns or controls, will, prior to entering into a contract to Transfer any of its property that is part of the Site, or 60 days prior to a Transfer of such property, whichever is earlier, (a) give written notice to the proposed transferee that the property is subject to this Settlement; and (b) give written notice to EPA of the proposed Transfer, including the name and address of the transferee. Respondent, for any Site property that it owns or controls, also agrees to require that its successors comply with this Section IX and Section XIX (Records).

51. Notwithstanding any provision of the Settlement, EPA retains all of its access authorities and rights, as well as all of its rights to require land, water, or other resource use restrictions, including related enforcement authorities under CERCLA, RCRA, and any other applicable statute or regulations.

X. FINANCIAL ASSURANCE

52. To ensure completion of Components 1 and 2 required under Section VIII, Respondent must secure financial assurance, initially in the amount of $3,332,496 ("Estimated Cost of the Components"), for the benefit of EPA. Should EPA determine that Components 3 and 4 are necessary, Respondent must secure financial assurance to ensure completion of Components 3 and 4 within 60 days of EPA's written notice to Respondent. The financial assurance must be one or more of the mechanisms listed below, in a form substantially identical to the relevant sample documents available from EPA, and be satisfactory to EPA. As of the date of signing this Settlement, the sample documents can be found under the "Financial Assurance - Settlements" category on the Cleanup Enforcement Model Language and Sample Documents Database at https://cfpub.epa.gov/compliance/models/. Respondent may use multiple mechanisms if it is limited to surety bonds guaranteeing payment, letters of credit, trust funds, or some combination thereof.

a. A surety bond guaranteeing payment, performance of the Components, or both, that is issued by a surety company among those listed as acceptable sureties on federal bonds as set forth in Circular 570 of the U.S. Department of the Treasury;

b. An irrevocable letter of credit, payable to EPA or at the direction of EPA, that is issued by an entity that has the authority to issue letters of credit and whose letter-of-credit operations are regulated and examined by a federal or state agency; or

c. A trust fund established for the benefit of EPA that is administered by a trustee that has the authority to act as a trustee and whose trust operations are regulated and examined by a federal or state agency.

53. Respondent has selected, and EPA has found satisfactory, a trust fund meeting the requirements of Section 52.c. as the form of financial assurance, in the form attached hereto as Appendix E. Within 30 days after the Effective Date, Respondent must secure all executed or otherwise finalized mechanisms or other documents consistent with the EPA-approved form of financial assurance and will submit such mechanisms and documents to EPA in accordance with Paragraph 94.

54. Respondent will diligently monitor the adequacy of the financial assurance. If Respondent becomes aware of any information indicating that the financial assurance provided under this Section is inadequate or otherwise no longer satisfies the requirements of this Section, Respondent must notify EPA of such information within 7 days. If EPA determines that the financial assurance provided under this Section is inadequate or otherwise no longer satisfies the requirements of this Section, EPA will notify Respondent of such determination. Respondent must, within 30 days after notifying EPA or receiving notice from EPA under this Paragraph, secure and submit to EPA for approval a proposal for a revised or alternative financial assurance mechanism that satisfies the requirements of this Section. EPA may extend this deadline for such time as is reasonably necessary for Respondent, in the exercise of due diligence, to secure and submit to EPA a proposal for a revised or alternative financial assurance mechanism, not to exceed 60 days. Respondent will follow the procedures of Paragraph 56 (Modification of Amount, Form, or Terms of Financial Assurance) in seeking approval of, and submitting documentation for, the revised or alternative financial assurance mechanism. Respondent's inability to secure financial assurance in accordance with this Section does not excuse performance of any other requirement of this Settlement.

55. **Access to Financial Assurance**

a. If EPA issues a notice of a Work Takeover under Paragraph 47.b, then, in accordance with any applicable financial assurance mechanism, EPA may require: (1) the performance of the Work; and/or (2) that any funds guaranteed be paid in accordance with Paragraph 55.d.

b. If EPA is notified that the issuer of a financial assurance mechanism intends to cancel the mechanism, and Respondent fails to provide an alternative financial assurance mechanism in accordance with this Section at least 30 days prior to the cancellation

date, the funds guaranteed under such mechanism must be paid prior to cancellation in accordance with Paragraph 55.d.

c. If, upon issuance of a notice of a Work Takeover under Paragraph 47, EPA is unable for any reason to promptly secure the resources guaranteed under any applicable financial assurance mechanism, whether in cash or in kind, to continue and complete the Work, then EPA is entitled to demand an amount, as determined by EPA, sufficient to cover the cost of the remaining Work to be performed. Respondent must, within 30 days after such demand, pay the amount demanded as directed by EPA.

d. Any amounts required to be paid under this Paragraph must be, as directed by EPA: (i) paid to EPA in order to facilitate the completion of the Work by EPA, the State, or by another person; or (ii) deposited into an interest-bearing account, established at a duly chartered bank or trust company that is insured by the FDIC, in order to facilitate the completion of the Work by another person. If payment is made to EPA, EPA may deposit the payment into the Fund or into the Special Account to be retained and used to conduct or finance response actions at or in connection with the Site, or to be transferred by EPA to the Fund.

56. **Modification of Amount, Form, or Terms of Financial Assurance**.

a. Financial Assurance Modification. Any financial assurance reduction request by Respondent must be accompanied by a cost estimate of the remaining Work, as identified in Paragraph 31.

(1) Pre-Settlement Financial Assurance Modification:

i. Respondent has entered into a contract with its contractor, Provectus Environmental Products, in the amount of $1,546,850, for part of Component 1. On or about July 11, 2022, Respondent prepaid $300,000 to its contractor, Provectus Environmental Products, for part of the Estimated Cost of Component 1. To account for this $300,000 prepayment, EPA has approved of a financial assurance reduction of the prepayment amount and the corresponding 60% margin of $180,000 to assure payment for performance, if necessary, of any Work by EPA (the "60% Margin"). This modified financial assurance requirement for part of the Estimated Cost of Component 1 involving Provectus Environmental Products is $1,246,850 plus $748,110 (60% Margin), totaling $1,994,960.

ii. Respondent has entered into a contract with its contractor, Hydrometrics, Inc., in the amount of $991,865, for part of Component 1 ($155,905) and Component 2 ($835,960). On or about July 11, 2022, Respondent prepaid $155,905 to its contractor, Hydrometrics, Inc., for part of the Estimated Cost of Component 1. To account for this $155,905 prepayment, EPA has approved of a financial assurance reduction of the prepayment

amount and the corresponding 60% Margin of $93,543 to assure payment for performance, if necessary, of any Work by EPA. This modified financial assurance requirement for part of the Estimated Cost of Components 1 and 2 involving Hydrometrics, Inc., is $835,960 plus $501,576 (60% Margin), totaling $1,337,536.

iii. The $3,332,496 figure reflected in Paragraph 52 is comprised of the totals of $1,994,960 in Subparagraph 56.a.1(i) and $1,337,536 in Subparagraph 56.a.1(ii). Respondent has provided satisfactory proof of prepayment, attached as Appendix D.

(2) Component 1: Respondent may reduce the amount of the financial assurance:

i. Upon EPA's approval of the Component 1 Construction Completion Report, submission of Respondent's estimated cost of the remaining Work plus the "60% Margin," and EPA's approval that the proposed financial assurance amount covers the estimated cost of the remaining Work plus the 60% Margin, as identified in Paragraph 31; or

ii. At any other time agreed to by the Parties, with EPA's approval that the proposed financial assurance amount covers the estimated cost of the remaining Work plus the 60% Margin, as identified in Paragraph 31.

iii. EPA shall use best efforts to approve Respondent's proposed adjustment pursuant to Paragraph 56(a)(2)(i) or (ii) within 45 days of EPA's receipt of Respondent's request.

iv. Upon receipt of EPA approval under Paragraph 56(a)(2)(i) or (ii), Respondent may request that the Trustee immediately release funds from the Trust to Respondent in an amount equal to the approved reduction of financial assurance.

(3) Component 2: Respondent may reduce the amount of the financial assurance:

i. Upon completion of each year of Work for Component 2, submission of Respondent's estimated cost of the remaining Work plus the 60% Margin, and EPA's approval that the proposed financial assurance amount covers the estimated cost of the remaining Work plus the 60% Margin, as identified in Paragraph 31; or

ii. At any other time agreed to by the Parties, with EPA's approval that the proposed financial assurance amount covers the estimated cost of the remaining Work plus the 60% Margin, as identified in Paragraph 31.

iii. EPA shall use best efforts to approve Respondent's proposed adjustment pursuant to Paragraph 56(a)(3)(i) or (ii) within 45 days of EPA's receipt of Respondent's request.

iv. Upon receipt of EPA approval under Paragraph 56(a)(3)(i) or (ii), Respondent may request that the Trustee immediately release funds from the Trust in an amount equal to the approved reduction of financial assurance.

(4) Consistent with Paragraph 52, Component 3: Respondent may reduce the amount of the financial assurance:

i. In its entirety upon EPA's written determination, in consultation with Montana Department of Environmental Quality, that Component 3 is unnecessary, based on the 2030 Five-Year Review.

ii. Upon EPA's approval of the Component 3 Construction Completion Report, submission of Respondent's estimated cost of the remaining Work plus the 60% Margin, and EPA's approval that the proposed financial assurance amount covers the estimated cost of the remaining Work plus the 60% Margin, as identified in Paragraph 31; or

iii. At any other time agreed to by the Parties, with EPA's approval that the proposed financial assurance amount covers the estimated cost of the remaining Work plus the 60% Margin, as identified in Paragraph 31.

iv. EPA shall use best efforts to approve Respondent's proposed adjustment pursuant to Paragraph 56(a)(4)(ii) or (iii) within 45 days of EPA's receipt of Respondent's request.

v. Upon receipt of EPA approval under Paragraph 56(a)(4)(ii) or (iii), Respondent may request that the Trustee immediately release funds from the Trust in an amount equal to the approved reduction of financial assurance.

(5) Consistent with Paragraph 52, Component 4: Respondent may request to reduce the amount of the financial assurance:

i. Upon EPA's written determination, in consultation with Montana Department of Environmental Quality, that Component 4 is unnecessary, based on the 2030 Five-Year Review.

ii. Upon completion of each year of Work for Component 4, submission of Respondent's estimated cost of the remaining Work plus the 60% Margin, and EPA's approval that the proposed financial assurance amount covers the estimated cost of the remaining Work plus the 60% Margin, as identified in Paragraph 31; or

iii. At any other time agreed to by the Parties, with EPA's approval that the proposed financial assurance amount covers the estimated cost of the remaining Work, as identified in Paragraph 31.

iv. EPA shall use best efforts to approve Respondent's proposed adjustment pursuant to Paragraph 56(a)(5)(ii) or (iii) within 45 days of EPA's receipt of Respondent's request.

v. Upon receipt of EPA approval under Paragraph 56(a)(5)(ii) or (iii), Respondent may request that the Trustee immediately release funds from the Trust in an amount equal to the approved reduction of financial assurance.

b. Any such request pursuant to Paragraph 56.a must be submitted to EPA in accordance with Paragraph 52, and must include an estimate of the cost of the remaining Work, an explanation of the bases for the cost calculation, and a description of the proposed changes, if any, to the form or terms of the financial assurance. EPA shall use best efforts to notify Respondent within 45 days of receiving a request to reduce the amount of financial assurance of its decision regarding the request. Respondent may modify the form, terms, or the amount of the financial assurance mechanism only in accordance with: (a) EPA's approval; or (b) any resolution of a dispute on the appropriate amount of financial assurance under Section XIV (Dispute Resolution). Any decision made by EPA on a request submitted under this Paragraph to change the form or terms of a financial assurance mechanism will not be subject to challenge by Respondent pursuant to the dispute resolution provisions of this Settlement or in any other forum. Respondent will submit to EPA, within 30 days after receipt of EPA's approval, or consistent with the terms of the resolution of the dispute, documentation of the change to the form, terms, or amount of the financial assurance instrument.

57. **Release, Cancellation, or Discontinuation of Financial Assurance**. Respondent may release, cancel, or discontinue any financial assurance provided under this Section only: (a) if EPA issues a Notice of Completion of Work under Paragraph 44 (Notice of Completion of Work); (b) in accordance with EPA's approval of such release, cancellation, or discontinuation; or (c) if there is a dispute regarding the release, cancellation, or discontinuance of any financial assurance, in accordance with the agreement or final decision resolving such dispute under Section XIV (Dispute Resolution).

XI. INDEMNIFICATION AND INSURANCE

58. Indemnification

a. The United States does not assume any liability by entering into this Settlement or by virtue of any designation of Respondent as EPA's authorized representative under section 104(e)(1) of CERCLA. Respondent will indemnify and save and hold harmless the United States, its officials, agents, employees, contractors, subcontractors, and representatives for or from any claims or causes of action arising from, or on account of, negligent or other wrongful acts or omissions of Respondent, its officers, directors, employees, agents, contractors, subcontractors, and any persons acting on Respondent's behalf or under its control, in carrying out activities under this Settlement, including any claims arising from any designation of Respondent as EPA's authorized representatives under section 104(e)(1) of CERCLA. Further, Respondent agrees to pay EPA all costs it incurs including attorneys' fees and other expenses of litigation and settlement arising from, or on account of, claims made against the United States based on negligent or other wrongful acts or omissions of Respondent, its officers, directors, employees, agents, contractors, subcontractors, and any persons acting on its behalf or under its control in carrying out activities under with this Settlement. EPA may not be held out as a party to any contract entered into by or on behalf of Respondent in carrying out activities under this Settlement. Respondent and any such contractor may not be considered an agent of EPA.

b. EPA will give Respondent notice of any claim for which EPA plans to seek indemnification in accordance with this Paragraph, and will consult with Respondent prior to settling such claim.

59. Respondent covenants not to sue and will not assert any claim or cause of action against the United States for damages or reimbursement or for set-off of any payments made or to be made to the United States, arising from or on account of any contract, agreement, or arrangement between Respondent and any person for performance of Work or other activities on or relating to the Site, including claims on account of construction delays. In addition, Respondent will indemnify and save and hold harmless the United States with respect to any claims for damages or reimbursement arising from or on account of any contract, agreement, or arrangement between Respondent and any person for performance of work at or relating to the Site, including claims on account of construction delays.

60. **Insurance**. Respondent will assure, by no later than 15 days before commencing any on-site Work, that the Respondent's contractor to perform the on-site In Situ Amendment Work has the following insurance: (a) commercial general liability insurance with limits of liability of $1 million per occurrence; (b) automobile liability insurance with limits of liability of $1 million per accident; and (c) umbrella liability insurance with limits of liability of $5 million in excess of the required commercial general liability and automobile liability limits. The insurance policy must name EPA as an additional insured with respect to all liability arising out of the activities performed by or on behalf of Respondent under this Settlement. Respondent will maintain this insurance until the first anniversary after EPA's issuance of the Notice of Completion of Work under Paragraph 44. In addition, for the duration of this Settlement,

Respondent will satisfy, or will ensure that its contractors or subcontractors satisfy, all applicable laws and regulations regarding the provision of worker's compensation insurance for all persons performing the Work on behalf of Respondent in furtherance of this Settlement. Prior to commencement of the Work, Respondent will provide to EPA certificates of such insurance and a copy of each insurance policy. Respondent will resubmit such certificates and copies of policies each year on the anniversary of the Effective Date. If Respondent demonstrates by evidence satisfactory to EPA that any contractor or subcontractor maintains insurance equivalent to that described above, or insurance covering the same risks but in a lesser amount, then, with respect to that contractor or subcontractor, Respondent need provide only that portion of the insurance described above that is not maintained by the contractor or subcontractor. Respondent will ensure that all submittals to EPA under this Paragraph identify the Site, Bozeman, Montana, and the EPA docket number of this case.

XII. PAYMENTS FOR RESPONSE COSTS

61. **Payments by Respondent for Future Response Costs**

a. **Periodic Bills**. On a periodic basis, EPA will send Respondent a bill for Future Response Costs that includes the standard Region 8 cost package report, listing direct and indirect costs paid by EPA, its contractors, and subcontractors. Respondent may initiate a dispute under Section XIV regarding a Future Response Cost billing, but only if the dispute relates to one or more of the following issues: (i) whether EPA has made an arithmetical error; (ii) whether EPA has included a cost item that is not within the definition of Future Response Costs; or (iii) whether EPA has paid excess costs as a direct result of an EPA action that was inconsistent with a specific provision or provisions of the NCP.

b. **Payment of Bill**. Respondent will pay the bill, or if they initiate dispute resolution, the uncontested portion of the bill, if any, within 30 days after receipt of the bill. Respondent will pay the contested portion of the bill determined to be owed, if any, within 30 days after the determination regarding the dispute. Each payment for: (i) the uncontested bill or portion of bill, if late, and; (ii) the contested portion of the bill determined to be owed, if any, must include an additional amount for Interest accrued from the date of receipt of the bill through the date of payment. Respondent will make payment at https://www.pay.gov using the "EPA Miscellaneous Payments Cincinnati Finance Center" link, and including references to the Site Name, Docket Number, and Site/Spill ID number and the purpose of the payment. Respondent must send notices of this payment to EPA in accordance with Section XX.

62. **Deposit of Payments**. EPA may, in its unreviewable discretion, deposit the amounts paid under Paragraph 61 in the Fund, in the Special Account, or both. EPA may, in its unreviewable discretion, retain and use any amounts deposited in the Special Account to conduct or finance response actions at or in connection with the Site, or transfer those amounts to the Fund.

XIII. FORCE MAJEURE

63. "Force majeure," for purposes of this Settlement, means any event arising from causes beyond the control of Respondent, of any entity controlled by Respondent, or of Respondent's contractors that delays or prevents the performance of any obligation under this Settlement despite Respondent's best efforts to fulfill the obligation. Given the need to protect public health and welfare and the environment, the requirement that Respondent exercise "best efforts to fulfill the obligation" includes using best efforts to anticipate any potential force majeure and best efforts to address the effects of any potential force majeure (a) as it is occurring and (b) following the potential force majeure such that the delay and any adverse effects of the delay are minimized to the greatest extent possible. "Force majeure" does not include financial inability to complete the Work, or increased cost of performance.

64. If any event occurs for which Respondent will or may claim a force majeure, Respondent will notify the Project Coordinator by email. The deadline for the initial notice is 30 days after the date Respondent first knew or should have known that the event would likely delay performance. Respondent will be deemed to know of any circumstance of which any contractor of, subcontractor of, or entity controlled by Respondent knew or should have known. Within 30 days thereafter, Respondent will send a further notice to EPA that includes: (i) a description of the event and its effect on Respondent's completion of the requirements of the Settlement; (ii) a description of all actions taken or to be taken to prevent or minimize the adverse effects or delay; (iii) the proposed extension of time for Respondent to complete the requirements of the Settlement; (iv) a statement as to whether, in the opinion of Respondent, such event may cause or contribute to an endangerment to public health or welfare, or the environment; and (v) all available proof supporting its claim of force majeure. EPA may, in its unreviewable discretion, excuse in writing Respondent's failure to submit timely or complete notices under this Paragraph.

65. EPA will notify Respondent of its determination whether Respondent is entitled to relief under Paragraph 63, and, if so, the duration of the extension of time for performance of the obligations affected by the force majeure. An extension of the time for performance of the obligations affected by the force majeure will not, of itself, extend the time for performance of any other obligation. Respondent may initiate dispute resolution under Section XIV regarding EPA's determination within 15 days after receipt of the determination. In any such proceeding, Respondent has the burden of proving that it is entitled to relief under Paragraph 63 and that its proposed extension was or will be warranted under the circumstances.

66. The failure by EPA to timely complete any activity under the Settlement is not a violation of the Settlement, provided, however, that if such failure prevents Respondent from timely completing a requirement of the Settlement, Respondent may seek relief under this Section.

XIV. DISPUTE RESOLUTION

67. Unless otherwise provided in this Settlement, Respondent must use the dispute resolution procedures of this Section to resolve any dispute arising under this Settlement.

68. A dispute will be considered to have arisen when one or more parties sends a written notice of dispute ("Notice of Dispute"). Disputes arising under this Settlement must in the first instance be the subject of informal negotiations between the parties to the dispute. If Respondent objects to any EPA action taken pursuant to this Settlement, it must send EPA a Notice of Dispute describing the objection(s) within 7 days after such action. The period for informal negotiations may not exceed 30 days after the dispute arises, unless EPA otherwise agrees. If the parties cannot resolve the dispute by informal negotiations, the position advanced by EPA is binding unless Respondent initiates formal dispute resolution under Paragraph 69. By agreement of both Parties, mediation may be used during this informal negotiation period to assist the parties in reaching a voluntary resolution or narrowing of the matters in dispute.

69. **Formal Dispute Resolution**.

a. **Statements of Position**. Respondent may initiate formal dispute resolution by submitting, within 7 days after the conclusion of informal dispute resolution under Paragraph 55, an initial Statement of Position regarding the matter in dispute. The EPA's responsive Statement of Position is due within 20 days after receipt of the initial Statement of Position. All Statements of Position must include supporting factual data, analysis, opinion, and other documentation. If appropriate, EPA may extend the deadlines for filing statements of position for up to 15 days and may allow the submission of supplemental statements of position.

b. **Formal Decision**. The Director of the Superfund and Emergency Management Division, EPA Region 8, will issue a formal decision resolving the dispute ("Formal Decision") based on the statements of position and any replies and supplemental statements of position. The Formal Decision is binding on Respondent, and will be incorporated into and become an enforceable part of this Settlement.

70. **Escrow Account**. For disputes regarding a Future Response Cost billing, Respondent must: (a) establish, in a duly chartered bank or trust company, an interest-bearing escrow account that is insured by the Federal Deposit Insurance Corporation ("FDIC"); (b) remit to that escrow account funds equal to the amount of the contested Future Response Costs; and (c) send to EPA, in accordance with Section XX, a copy of the transmittal letter and check paying the uncontested Future Response Costs, and a copy of the correspondence that established and funded the escrow account, including the name of the bank, the bank account number, and a bank statement showing the initial balance in the account. EPA may, in its unreviewable discretion, waive the requirement to establish the escrow account. Respondent will cause the escrow agent to pay the amounts due to EPA under Paragraph 61, if any, by the deadline for such payment in Paragraph 61. Respondent is responsible for any balance due under Paragraph 61 after the payment by the escrow agent.

71. The initiation of dispute resolution procedures under this Section does not extend, postpone, or affect in any way any requirement of this Settlement, except as provided in Paragraph 61.b (Contesting Future Response Costs) or as EPA agrees. Stipulated penalties with respect to the disputed matter will continue to accrue, but payment is stayed pending resolution of the dispute, as provided in Paragraph 74.

XV. STIPULATED PENALTIES

72. Unless the noncompliance is excused under Section XIII (Force Majeure), Respondent is liable to EPA for the following stipulated penalties:

a. For any failure: (i) to pay any amount due under Section XII; (ii) to establish and maintain financial assurance in accordance with Section X; (iii) to establish any escrow account required under Paragraph 70 (as related to Dispute Resolution); (iv) to submit timely or adequate deliverables, specifically the In Situ Amendments Work Plan:

Period of Noncompliance	Penalty Per Noncompliance Per Day
1st through 14th day	$1,000
15th through 30th day	$2,000
31st day and beyond	$5,000

b. For any failure to submit timely or adequate deliverables required by this Settlement other than those specified in Paragraph 72.b:

Period of Noncompliance	Penalty Per Noncompliance Per Day
1st through 14th day	$750
15th through 30th day	$1,500
31st day and beyond	$3,000

73. **Work Takeover Penalty**. If EPA commences a Work Takeover under Paragraph 47, Respondent is liable for a stipulated penalty in the amount of $40,000. This stipulated penalty is in addition to the remedy available to EPA under Paragraph 55 (Access to Financial Assurance).

74. **Accrual of Penalties**. Stipulated penalties accrue from the date performance is due, or the day a noncompliance occurs, whichever is applicable, until the date the requirement is completed or the final day of the correction of the noncompliance. Nothing in this Settlement prevents the simultaneous accrual of separate penalties for separate noncompliances with this Settlement. Stipulated penalties accrue regardless of whether Respondent has been notified of its noncompliance, and regardless of whether Respondent has initiated dispute resolution under Section XIV, provided, however, that no penalties will accrue as follows:

a. With respect to a submission that EPA subsequently determines is deficient, during the period, if any, beginning on the 31st day after EPA's receipt of such submission until the date that EPA notifies Respondent of any deficiency; or

b. With respect to a matter that is the subject of dispute resolution under Section XIV, during the period, if any, beginning on the 21st day after EPA's Statement of Position is received until the date of the Formal Decision under Paragraph 69.

75. **Demand and Payment of Stipulated Penalties**. EPA may send Respondent a demand for stipulated penalties. The demand will include a description of the noncompliance and will specify the amount of the stipulated penalties owed. Respondent may initiate dispute resolution under Section XIV within 30 days after receipt of the demand. Respondent will pay the amount demanded or, if it initiates dispute resolution, the uncontested portion of the amount demanded, within 30 days after receipt of the demand. Respondent will pay the contested portion of the penalties determined to be owed, if any, within 30 days after the resolution of the dispute. Each payment for: (a) the uncontested penalty demand or uncontested portion, if late; and (b) the contested portion of the penalty demand determined to be owed, if any, must include an additional amount for Interest accrued from the date of receipt of the demand through the date of payment. Respondent will make payment at https://www.pay.gov using the link for "EPA Miscellaneous Payments Cincinnati Finance Center," including references to the Site Name, Docket Number, and Site/Spill ID number and the purpose of the payment. Respondent must send notices of this payment to EPA in accordance with Section XX. The payment of stipulated penalties and Interest, if any, does not alter any obligation by Respondent under the Settlement.

76. Nothing in this Settlement limits the authority of the EPA to seek any other remedies or sanctions available by virtue of Respondent's noncompliances with this Settlement or of the statutes and regulations upon which it is based, including penalties under sections 106(b) and 122(l) of CERCLA, and punitive damages pursuant to section 107(c)(3), provided, however, that the EPA may not seek civil penalties under section 122(l) of CERCLA for any noncompliance for which a stipulated penalty is provided for in this Settlement, except in the case of a willful noncompliance with this Settlement or in the event that EPA assumes performance of a portion or all of the Work pursuant to Paragraph 47 (Work Takeover).

77. Notwithstanding any other provision of this Section, the EPA may, in its unreviewable discretion, waive any portion of stipulated penalties that have accrued under this Settlement.

XVI. COVENANTS BY EPA

78. **Covenants for Respondent**. Subject to Paragraph 80, EPA covenants not to sue or to take administrative action against Respondent under to sections 106 and 107(a) of CERCLA regarding the Work and Future Response Costs.

79. The covenants under Paragraph 78: (a) take effect upon the Effective Date; (b) are conditioned on the complete and satisfactory performance by Respondent of the requirements of this Settlement; (c) extend to the successors of Respondent but only to the extent that the alleged liability of the successor of Respondent is based solely on its status as a successor of Respondent; and (d) do not extend to any other person.

80. **General Reservations**. EPA reserves, and this Settlement is without prejudice to, all rights against Respondent regarding the following:

a. Liability for failure by Respondent to meet a requirement of this Settlement;

b. Liability for performance of response action other than the Work;

c. Liability for damages for injury to, destruction of, or loss of natural resources, and for the costs of any natural resource damage assessments; and

d. Liability arising from the past, present, or future disposal, release or threat of release of Waste Materials outside of the Site; and

e. Criminal liability.

81. Subject to Paragraph 78, nothing in this Settlement limits any authority of EPA to take, direct, or order all appropriate action to protect human health and the environment or to prevent, abate, respond to, or minimize an actual or threatened release of Waste Material on, at, or from the Site, or to request a Court to order such action.

XVII. COVENANTS BY RESPONDENT

82. **Covenants by Respondent**

a. Subject to Paragraph 83, Respondent covenants not to sue and will not assert any claim or cause of action against the United States under CERCLA, section 7002(a) of RCRA, the United States Constitution, the Tucker Act, 28 U.S.C. § 1491, the Equal Access to Justice Act, 28 U.S.C. § 2412, the State Constitution, State law, or at common law regarding, regarding the Work, Future Response Costs, and this Settlement.

b. Subject to Paragraph 83, Respondent covenants not to seek reimbursement from the Fund through CERCLA or any other law for costs of the Work, Future Response Costs, or any claim arising out of response actions at or in connection with the Site.

83. **Respondent's Reservation**. The covenants in Paragraph 82 do not apply to any claim or cause of action brought, or order issued, after the Effective Date by the United States to the extent such claim, cause of action, or order is within the scope of a reservation under Paragraphs 80.a through 80.e.

XVIII. EFFECT OF SETTLEMENT/CONTRIBUTION

84. The Parties agree that: (a) this Settlement constitutes an administrative settlement under which Respondent has, as of the Effective Date, resolved its liability to the United States within the meaning of sections 113(f)(2), 113(f)(3)(B), and 122(h)(4) of CERCLA; and (b) Respondent is entitled, as of the Effective Date, to protection from contribution actions or claims

as provided by sections 113(f)(2) and 122(h)(4) of CERCLA, or as may be otherwise provided by law, for the "matters addressed" in this Settlement. The "matters addressed" in this Settlement are the Work and Future Response Costs, provided, however, that if the United States exercises rights against Respondent under the reservations in Paragraphs 80.a through 80.e, the "matters addressed" in this Settlement will no longer include those response costs or response actions that are within the scope of the exercised reservation.

85. Respondent will, with respect to any suit or claim brought by it for matters related to this Settlement, notify EPA no later than 60 days prior to the initiation of such suit or claim. Respondent will, with respect to any suit or claim brought against it for matters related to this Settlement, notify EPA within 10 days after service of the complaint on Respondent. In addition, Respondent will notify EPA within 10 days after service or receipt of any Motion for Summary Judgment and within 10 days after receipt of any order from a court setting a case for trial.

86. **Res Judicata and Other Defenses**. In any subsequent administrative or judicial proceeding initiated against Respondent by EPA or by the United States on behalf of EPA for injunctive relief, recovery of response costs, or other appropriate relief relating to the Site, Respondent will not assert, and may not maintain, any defense or claim based upon the principles of waiver, claim preclusion (res judicata), issue preclusion (collateral estoppel), claim-splitting, or other defenses based upon any contention that the claims raised by the United States in the subsequent proceeding were or should have been brought in the instant case.

87. Nothing in this Settlement creates any rights in, or grants any defense or cause of action to, any person not a Party to this Settlement. Except as provided in Section XVII (Covenants by Respondent), each of the Parties expressly reserves any and all rights (including pursuant to section 113 of CERCLA), defenses, claims, demands, and causes of action that each Party may have with respect to any matter, transaction, or occurrence relating in any way to the Site against any person not a Party hereto. Nothing in this Settlement diminishes the right of the United States under section 113(f)(2) and (3) of CERCLA to pursue any person not a party to this Settlement to obtain additional response costs or response action and to enter into settlements that give rise to contribution protection pursuant to section 113(f)(2).

XIX. RECORDS

88. **Respondent's Certification**. Respondent certifies that: (a) it has implemented a litigation hold on documents and electronically stored information relating to the Site, including information relating to its potential liability under CERCLA regarding the Site, since the notification of potential liability by the United States or the State; and (b) it has fully complied with any and all EPA requests for information under sections 104(e) and 122(e) of CERCLA, and section 3007 of RCRA.

89. **Retention of Records and Information**

a. Respondent will retain, and instruct its contractors and agents to retain, the following documents and electronically stored data ("Records") until 10 years after the Notice of Completion of the Work under Paragraph 44 ("Record Retention Period"):

(1) All records regarding Respondent's liability and the liability of any other person under CERCLA regarding the Site;

(2) All reports, plans, permits, and documents submitted to EPA in accordance with this Settlement, including all underlying research and data; and

(3) All data developed by, or on behalf of, Respondent in the course of performing the Work.

b. At the end of the Record Retention Period, Respondent must notify EPA that EPA has 90 days to request the Respondent's Records subject to this Section. Respondent must retain and preserve its Records subject to this Section until 90 days after EPA's receipt of the notice. These record retention requirements apply regardless of any corporate record retention policy.

90. Respondent must provide to EPA, upon request, copies of all Records and information required to be retained under this Section. Respondent must also make available to EPA, for purposes of investigation, information gathering, or testimony, Respondent's employees, agents, or representatives with knowledge of relevant facts concerning the performance of the Work.

91. **Privileged and Protected Claims**

a. Respondent may assert that all or part of a Record requested by EPA is privileged or protected as provided under federal law, in lieu of providing the record, provided that Respondent complies with Paragraph 91.b, and except as provided in Paragraph 91.c.

b. If Respondent asserts a claim of privilege or protection, Respondent must provide EPA with the following information regarding such Record: (i) title; (ii) date; (iii) name, title, affiliation (e.g., company or firm), and address of the author, of each addressee, and of each recipient; (iv) description of the Records contents; and (v) the privilege or protection asserted. If a claim of privilege or protection applies only to a portion of a record, Respondent will provide the record to EPA in redacted form to mask the privileged or protected portion only. Respondent must retain all records that it claims to be privileged or protected until EPA has had a reasonable opportunity to dispute the privilege or protection claim and any such dispute has been resolved in Respondent's favor.

c. Respondent will not make any claim of privilege or protection regarding: (i) any data regarding the Site, including all sampling, analytical, monitoring, hydrogeologic, scientific, chemical, radiological or engineering data, or the portion of any other record that evidences conditions at or around the Site; or (ii) the portion of any record that Respondent is required to create or generate in accordance with this Settlement.

92. **Confidential Business Information (CBI) Claims**. Respondent may claim that all or part of a record provided to EPA under this Section is CBI to the extent permitted by and in accordance with section 104(e)(7) of CERCLA and 40 C.F.R. § 2.203(b). Respondent must segregate and clearly identify all records or parts thereof submitted under this Settlement for which they claim is CBI by labeling each page or each electronic file "claimed as confidential business information" or "claimed as CBI." Records that Respondent claims to be CBI will be afforded the protection specified in 40 C.F.R. part 2, subpart B. If no CBI claim accompanies records when they are submitted to EPA, or if EPA notifies Respondent that the records are not entitled to confidential treatment under the standards of section 104(e)(7) of CERCLA or 40 C.F.R. part 2, subpart B, the public may be given access to such records without further notice to Respondent.

93. Notwithstanding any provision of this Settlement, EPA retains all of its information gathering and inspection authorities and rights, including enforcement actions related thereto, under CERCLA, RCRA, and any other applicable statutes or regulations.

XX. NOTICES AND SUBMISSIONS

94. All agreements, approvals, consents, deliverables, modifications, notices, notifications, objections, proposals, reports, waivers, and requests specified in this Settlement must be in writing unless otherwise specified. Whenever a notice is required to be given or a report or other document is required to be sent by one Party to another under this Settlement, it must be sent as specified below. All notices under this Section are effective upon receipt, unless otherwise specified. In the case of emailed notices, there is a rebuttable presumption that such notices are received on the same day that they are sent. Any Party may change the method, person, or address applicable to it by providing notice of such change to all Parties.

As to EPA: *via email to*:
Betsy Smidinger, Direct, Superfund & Emergency Management Division
smidinger.betsy@epa.gov

Roger Hoogerheide, Remedial Project Manager
hoogerheide.roger@epa.gov

Julie Nicholson, Environmental Protection Specialist
nicholson.julie@epa.gov

Mark Chalfant, Senior Assistant Regional Counsel
chalfant.mark@epa.gov

Kayleen Castelli, Senior Assistant Regional Counsel
castelli.kayleen@epa.gov

Re: Site/Spill ID # 0863

As to Respondent: *via email to*:
Les Lonning, Project Coordinator
Les.Lonning@gmail.com

Heidi Kaiser, Project Coordinator
HKaiser@hydrometrics.com

Christopher R. Hermann, Stoel Rives LLP
Chris.hermann@stoel.com

Gregory D. McFarland
GregM@cdrmgt.com

XXI. APPENDICES

95. The following appendices are attached to and incorporated into this Settlement:

"Appendix A" is the map of the Site.

"Appendix B" is the Work Plan.

"Appendix C" is the list of Focused Feasibility Study ARARs.

"Appendix D" is the proof of financial assurance prepayment.

"Appendix E" is the form of the Idaho Pole Co. financial assurance trust fund.

XXII. MODIFICATIONS

96. The RPM may modify any plan or schedule or Work Plan in writing or by oral direction. EPA will promptly memorialize in writing any oral modification, which will be effective on the date of the RPM's oral direction. Any other requirements of this Settlement may be modified in writing by mutual agreement of the parties.

97. If Respondent seeks permission to deviate from any approved In Situ Amendments Work Plan or schedule or the Work Plan, Respondent's Project Coordinator will submit a written request to EPA for approval outlining the proposed modification and its basis. Respondent may not proceed with a requested deviation until receiving oral or written approval from the RPM pursuant to Paragraph 87.

98. No informal advice, guidance, suggestion, or comment by the RPM or other EPA representatives regarding any deliverable submitted by Respondent relieves Respondent of its obligation to obtain any formal approval required by this Settlement, or to comply with all requirements of this Settlement, unless it is formally modified.

XXIII. SIGNATORIES

99. Each undersigned representative of EPA and undersigned representative of Respondent certifies that they are fully authorized to enter into the terms and conditions of this Settlement and to execute and legally bind such party to this Settlement.

XXIV. INTEGRATION

100. This Settlement constitutes the entire agreement among the Parties regarding the subject matter of the Settlement and supersedes all prior representations, agreements and understandings, whether oral or written, regarding the subject matter of the Settlement.

XXV. EFFECTIVE DATE

101. This Settlement is effective 1 day after the Settlement is signed by the Regional Administrator or their delegatees.

IT IS SO AGREED AND ORDERED:

BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY:

Bielenberg, Ben

Digitally signed by Bielenberg, Ben
Date: 2022.07.26 10:22:13 06'00'

_____
Dated

for Betsy Smidinger
Division Director, Region 8
Superfund & Emergency Management Division U.S. Environmental Protection Agency

IT IS SO AGREED AND ORDERED:

BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY:

CHRISTOPHER THOMPSON
Digitally signed by CHRISTOPHER THOMPSON
Date: 2022.07.26 12:56:19 -06'00'

_____ _____

Dated

Christopher A. Thompson
Associate Regional Counsel for Enforcement
Office of Regional Counsel
U.S. Environmental Protection Agency

Signature Page for Settlement Regarding the Idaho Pole Co. Superfund Site

FOR: IDAHO POLE CO.

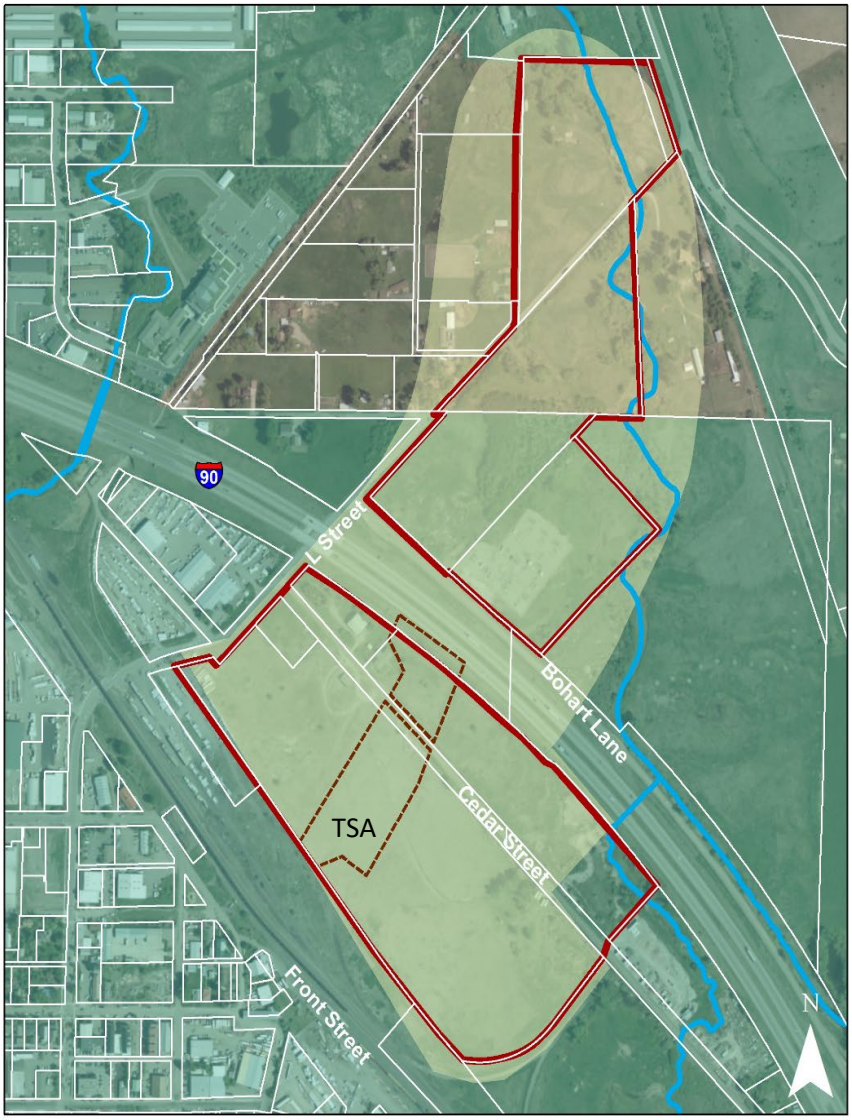
7.19.2022
Dated

Greg D. Farl
Name: Greg D. McFarland
Title: Co-President / Director
Address: 3325 Meridian Ave E, STE 4
Edgewood, WA 98371

April 2022

Appendix A
Site Map

For Administrative Settlement Agreement and Order on Consent
for In Situ Amendments in Support of Focused Feasibility Study
Idaho Pole Company Superfund Site
Bozeman, Montana



0 250 500 1,000 Feet

Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USGS, AeroGRID, IGN and the GIS User Community.

Legend

- Approximate Site Boundary
- Treated Soil Area
- CGA
- Parcels
- City of Bozeman
- Streams

Appendix B

Work Plan
IN SITU AMENDMENTS AND PERFORMANCE MONITORING IN SUPPORT OF FOCUSED FEASIBILITY STUDY

Idaho Pole Co. Superfund Site
Bozeman, Gallatin County, Montana

Prepared for:
U.S. Environmental Protection Agency
Region VIII, Montana Office
Federal Building, Suite 3200
10 West 15th Street
Helena, MT 59626

Prepared by:
Hydrometrics
5602 Hesper Rd.
Billings, MT 59106-3236

Hydrometrics, on behalf of the Idaho Pole Company (hereinafter, "IPC"), hereby submits this Work Plan for the performance of in situ amendments and performance monitoring in support of the Focused Feasibility Study (FFS) at the Idaho Pole Co. Superfund Site pursuant to the terms and conditions of the Administrative Settlement Agreement and Order on Consent (ASAOC) entered into by the United States Environmental Protection Agency (EPA) and IPC.

Prepared by: Heidi Kaiser Date: July 11, 2022

Heidi Kaiser, Hydrometrics Project Coordinator

Reviewed by: Angela McQueen Date: 07/11/2022

Angela McQueen, Hydrometrics Quality Assurance Manager

Issued by: Les Lonning Date: 7/11/2022

Les Lonning, Idaho Pole Co. Environmental Manager and Primary Project Coordinator

Approved by: Roger Hoogerheide Digitally signed by Roger Hoogerheide Date: 2022.07.12 22:19:27 -06'00' Date: _____

Roger Hoogerheide, Remedial Project Manager and Delegated Quality Assurance Approving Official, U.S. Environmental Protection Agency

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List of Acronyms and Abbreviations

ASAOC	**Administrative Settlement Agreement and Order on Consent**
BFEG	**Bark Fill Extraction Gallery**
BGS	**Below Ground Surface**
CERCLA	**Comprehensive Environmental Response, Compensation, and Liability Act**
CoC	**Contaminant of Concern**
DO	**Dissolved Oxygen**
DQA	**Data Quality Assessment**
DQO	**Data Quality Objectives**
EDD	**Electronic Data Deliverable**
EPA	**U.S. Environmental Protection Agency**
FFS	**Focused Feasibility Study**
FSP	**Field Sampling Plan**
Ft/D	**Feet per Day**
GRS	**Groundwater Recovery System**
GPD/FT	**Gallons per Day per Foot**
HASP	**Health and Safety Plan**
I-90	**Interstate 90**
IDW	**Investigative Derived Waste**
IPC	**Idaho Pole Company**
ISCO	**In Situ Chemical Oxidation**
ISCR	**In Situ Chemical Reduction**
Kg	**Kilogram**
LNAPL	**Light Non-Aqueous Phase Liquid**
MDEQ	**Montana Department of Environmental Quality**
MDL	**Method Detection Limits**
MS/MSD	**Matrix Spike/ Matrix Spike Duplicate**
NAPL	**Non Aqueous Phase Liquid**
NCP	**National Contingency Plan**
OU	**Operable Unit**
ORP	**Oxidation Reduction Potential**
PAH	**Polycyclic Aromatic Hydrocarbons**
PCP	**Pentachlorophenol**
PDF	**Portable Document Formatted**
PHC	**Petroleum Hydrocarbon**
PQL	**Practical Quantitation Limit**
PRB	**Permeable Reactive Barrier**
QA	**Quality Assurance**
QAP	**Quality Assurance Plan**
QAPP	**Quality Assurance Project Plan**
QC	**Quality Control**
QMP	**Quality Management Plan**
RA	**Remedial Action**

RAO	**Remedial Action Objective**
RD	**Remedial Design**
RI	**Remedial Investigation**
ROD	**Record of Decision**
RPM	**Remedial Project Manager**
SAP	**Sampling and Analysis Plan**
SOD	**Soil Oxidant Demand**
SOP	**Standard Operating Procedure**
SOW	**Scope of Work**
TOC	**Total Organic Carbon**
TOD	**Total Oxidant Demand**
UAO	**Unilateral Administrative Order**
ZVI	**Zero Valent Iron**

Revision Tracking Table

Revision Number	Date	Section Revised	Changes/Comments
1	4/7/22	ALL	Preliminary Draft
2	6/3/22	ALL	Draft
3	6/30/22	ALL	Draft Final
4	7/11/22	ALL	FINAL

1. Introduction

This Work Plan has been prepared for inclusion in the Administrative Settlement Agreement and Order on Consent (ASAOC) for the Idaho Pole Co. (IPC) Superfund Site (Site), Bozeman, Montana (**Figure 1-1**). As a result of the successful excavation and treatment of contaminated soil and groundwater and limited testing of bio-amendments in the subsurface around the Bark Fill Area (a 26,000 square foot area between Cedar Street and Interstate 90 (I-90)), the U.S. Environmental Protection Agency (EPA), in consultation with Montana Department of Environmental Quality (MDEQ), agreed to terminate operation of the Groundwater Recovery System and consider other alternatives to address the residual contamination. This Work Plan provides for implementation of in situ amendments as part of the Focused Feasibility Study (FFS) and provides the deliverables and schedule to monitor its performance for the first nine months.

The work components as described in Paragraph 31 of the ASAOC include the following four components:

1. In Situ (in place) Amendments
2. Seven Years of Performance Monitoring through 2030 Five-Year Review
3. In Situ Amendments (Contingency – as determined necessary by EPA)
4. Five Years of Performance Monitoring through 2035 Five-Year Review (Contingency – as determined necessary by EPA)

This Work Plan addresses the Deliverables, Specifications and Approval requirements for Component 1 and the initial first nine months of performance monitoring required under Component 2. Respondent must submit a Component 2 Interim Report within 30 days after the third quarter analytical data has been validated, which presents an evaluation of the first three quarters in lieu of a Progress Report specified in **Section 6.8.1**. The Respondent must also submit a Revised Work Plan to address any performance monitoring modifications necessary to complete the Component 2 Performance Monitoring within 15 days after the Component 2 Interim Report has been accepted by EPA. The Respondent will be required to continue monitoring at the frequency required under this Work Plan until a Revised Work Plan has been approved by EPA. If at any time during Component 2 Performance Monitoring EPA determines it is necessary to implement Components 3 and 4, EPA will notify the Respondent in writing that those Work Plans are required under the ASAOC. The Respondent must provide a Revised Work Plan that addresses Components 3 and 4 within 45 days of receiving EPA's notification.

1.1. Purpose of the Work Plan

Considering the Site conditions, contaminants, and remedial actions objectives, in situ amendments of a chemical oxidant is proposed combined with enhanced bioremediation technologies. In situ amendments will be injected into the 26,000 square foot Bark Fill Area and three down gradient permeable reactive barriers (PRBs). The on-Site treatment in the Bark Fill Area will target the contamination source to reduce groundwater contamination through time. Down gradient of the source treatment, just north of the interstate and near monitoring well 25-B and 27-B (**Figure 1-2**), PRBs will be used to treat passing contaminants migrating from the source area to remediate the groundwater plume (Provectus, 2022). This Work Plan also presents a plan for the continued monitoring and evaluation of contaminant concentration trends for nine months following in situ injections. Once

three quarters of monitoring data are available, decisions to be made by EPA as part of Component 2 of this Work Plan may include but are not limited to:

1) Expansion or reduction of groundwater monitoring; and
2) Initiation of contingency work.

1.2. Work Plan Organization

This Work Plan guides the implementation of in situ amendments in support of the FFS as well as the first nine months of performance monitoring. The in situ amendments will be injected in 2022, assuming necessary authorizations have been obtained and weather conditions allow. The proposed in situ amendments are based on scientific literature, historic Site data, meetings with Provectus, which is a vendor of In Situ Chemical Oxidation (ISCO) reagents, best management practices, and EPA guidance.

Data collection efforts associated with Component 1 will be restricted to collection of groundwater at the outset of the project (Spring 2022) under an approved Work Plan (Hydrometrics 2018), collection of soil samples for soil oxidant demand treatability testing under an approved Work Plan (Hydrometrics April 2022), qualitative measurements collected during injections of in situ amendments and three quarters of sampling under an EPA approved Quality Assurance Project Plan that is presented in this Work Plan. This Work Plan also includes the elements of a Sampling and Analysis Plan (SAP), a Field Sampling Plan (FSP), a Quality Assurance/Quality Control (QA/QC) plan, and a Quality Management Plan (QMP). The accompanying QAPP generated for Component 2 has been developed in general accordance with the EPA's *Requirements for Quality Assurance Project Plans, EPA QA/R-5* (U.S. EPA, 2001), and is consistent with the National Contingency Plan (NCP), and will include all the data elements required in EPA's Region 8 Quality Assurance Document Review Crosswalk, *Guidance for Quality Assurance Project Plans (QA/G-5),* EPA/240/R-02/009 (December 2002), *Guidance for Quality Assurance Project Plans (QA/G-5)* EPA/240/R-02/009 (December 2002), *EPA Requirements for Quality Assurance Project Plans (QA/R-5)* EPA/240/B-01/003 (March 2001, reissued May 2006), and *Uniform Federal Policy for Quality Assurance Project Plans*, Parts 1-3, EPA/505/B-04/900A-900C (March 2005). Defensibility of the data obtained will be ensured by following EPA-approved sample collection protocols in the field and lab, as well as EPA-approved analytical methods conducted by a certified external laboratory.

The organization of the Work Plan is as follows:

- Section 1.0: Introduction
- Section 2.0: Site Background and Setting
- Section 3.0: Work to be Performed
- Section 4.0: Measurement and Data Acquisition
- Section 5.0: Data Validation and Usability
- Section 6.0: Performance Monitoring and Evaluation
- Section 7.0: References

1.3. Project Management

The Project Team organizational chart is presented in **Figure 1-3** and the contact information plus responsibilities for key project personnel are provided in **Table 1-1**.

1.3.1. Environmental Protection Agency

Mr. Roger Hoogerheide is the EPA Remedial Project Manager (RPM) for the Site. EPA is the lead agency and is responsible for all regulatory oversight of the Work Plan.

1.3.2. Idaho Pole Company

IPC is the Respondent and will perform the work required under the ASAOC and as identified in this Work Plan. Mr. Les Lonning is Idaho Pole's Environmental Manager and primary IPC Project Coordinator under the ASAOC.

For field scale work associated with Components 1 and 2, IPC proposes to use Hydrometrics as its primary environmental contractor and EPA has not disapproved of Hydrometrics. Hydrometrics' primary responsibilities under this Work Plan include contracting and procurement, performance (field) oversight, providing water to mix with amendments, traffic control, permitting, and reporting. As part of Component 1, Hydrometrics will be responsible for securing access to the treatment areas and for receiving shipments of in situ amendments and safely securing them on Site. Hydrometrics will be responsible for securing a water source and supplying the holding tanks to mix water with the in situ amendments. Hydrometrics will also maintain overall project responsibility for all four work components contemplated under this ASAOC and will maintain IPC contact and control of the Site. Heidi Kaiser is Hydrometrics' Project Coordinator for the Site. Other qualified individuals within Hydrometrics form the remainder of the project team and may be assigned duties by Hydrometrics' Project Coordinator as necessary.

1.3.3. Provectus

IPC proposes to use Provectus Environmental Products, Inc. (Provectus) for environmental biotechnology, design support, and in situ amendment application services. Provectus has selected Andrew Lowry to be the Technical Design Coordinator. Through approval of this Work Plan, EPA has not disapproved of Provectus as an environmental subcontractor to implement in situ amendments contemplated under Component 1. In addition to providing the in situ amendments, Provectus will also provide and arrange delivery of in situ amendments to the Site and will be responsible for remedial construction contracting (e.g., injection and drilling). A Provectus statement of qualifications is included in **Appendix A**.

1.3.4. Montana Department of Environmental Quality (MDEQ)

Mr. Gordon Levin is the MDEQ Project Officer for the Site. Mr. Levin has all responsibilities on behalf of the MDEQ on the project and works directly with EPA in the regulatory oversight of the project.

1.4. Project Schedule and Deliverables

The projected schedule for this Work Plan is triggered by execution of the ASAOC, weather/access permitting, as shown in **Table 1-2.** If the project schedule needs to be modified due to weather, access issues or unforeseen delays, IPC is required to submit in writing a proposed schedule modification for EPA approval.

1.5. Distribution List

This Work Plan is an enforceable document under the ASAOC. A signed copy of this Work Plan will be included as Appendix B to the ASAOC. Any future Work Plan revisions will be incorporated by reference into the ASAOC, and are also enforceable documents under the ASAOC. Electronic copies of this Work Plan, as well as any revisions that accurately reflect completed and/or anticipated work, will be provided to the EPA Remedial Project Manager and MDEQ Project Officer by a Respondent Project Coordinator. A signed copy of this Work Plan and any revisions will also be placed in the Superfund site file.

1.6. Special Training/Certifications

Field team members will have the necessary skills to complete the field sampling techniques and sampling methods outlined in this SAP/QAPP and the standard operating procedures (SOPs) provided in **Appendix C**. To ensure that all personnel performing work have the necessary skills to safely and effectively accomplish their work, special training requirements for any personnel working on this investigation will include the following:

- Documented OSHA 40-hour HAZWOPER certification and current 8-hour refresher
- Documented CPR/First Aid certification

Hydrometrics will be responsible for providing these trainings to staff using qualified trainers. Hydrometrics will also ensure that any subcontractors have completed the appropriate training. The Project Team will document in the project file that personnel have and maintain the appropriate training, knowledge, skills, and qualifications necessary to perform the work outlined in this Work Plan and the need for retraining will be assessed if project requirements change. The training documentation for Hydrometrics personnel is stored in the project file, whereas the trainings and documentation for EPA, IPC and MDEQ personnel are managed by the individual and their respective organizations.

Table 1-1. Key Project Personnel Contact Information and Responsibilities.

Name/Title	Phone/email	Responsibilities
Roger Hoogerheide EPA Remedial Project Manager	406-457-5031 Hoogerheide.roger@epa.gov	Responsible for all regulatory oversight of the Work Plan
Les Lonning IPC Environmental Manager and Primary Project Coordinator	253-878-4647 Les.lonning@gmail.com	Perform the work required under the ASAOC and as identified in this Work Plan
Heidi Kaiser Hydrometrics Project Coordinator	406-697-0410 hkaiser@hydrometrics.com	Maintain overall project responsibility for all four work components contemplated under this ASAOC and will maintain IPC contact and control of the Site
Andrew Lowy Provectus Technical Design Coordinator	480-670-7278 andy.lowy@provectusenv.com	Implement in situ amendments contemplated under Component 1. Provide the in situ amendments, arrange delivery of in situ amendments to the Site and be responsible for remedial construction contracting (e.g., injection and drilling).
Gordon Levin MDEQ State Project Officer	406-444-6569 glevin@mt.gov	Responsibilities on behalf of the MDEQ on the Work Plan and works directly with EPA in the regulatory oversight of the project.

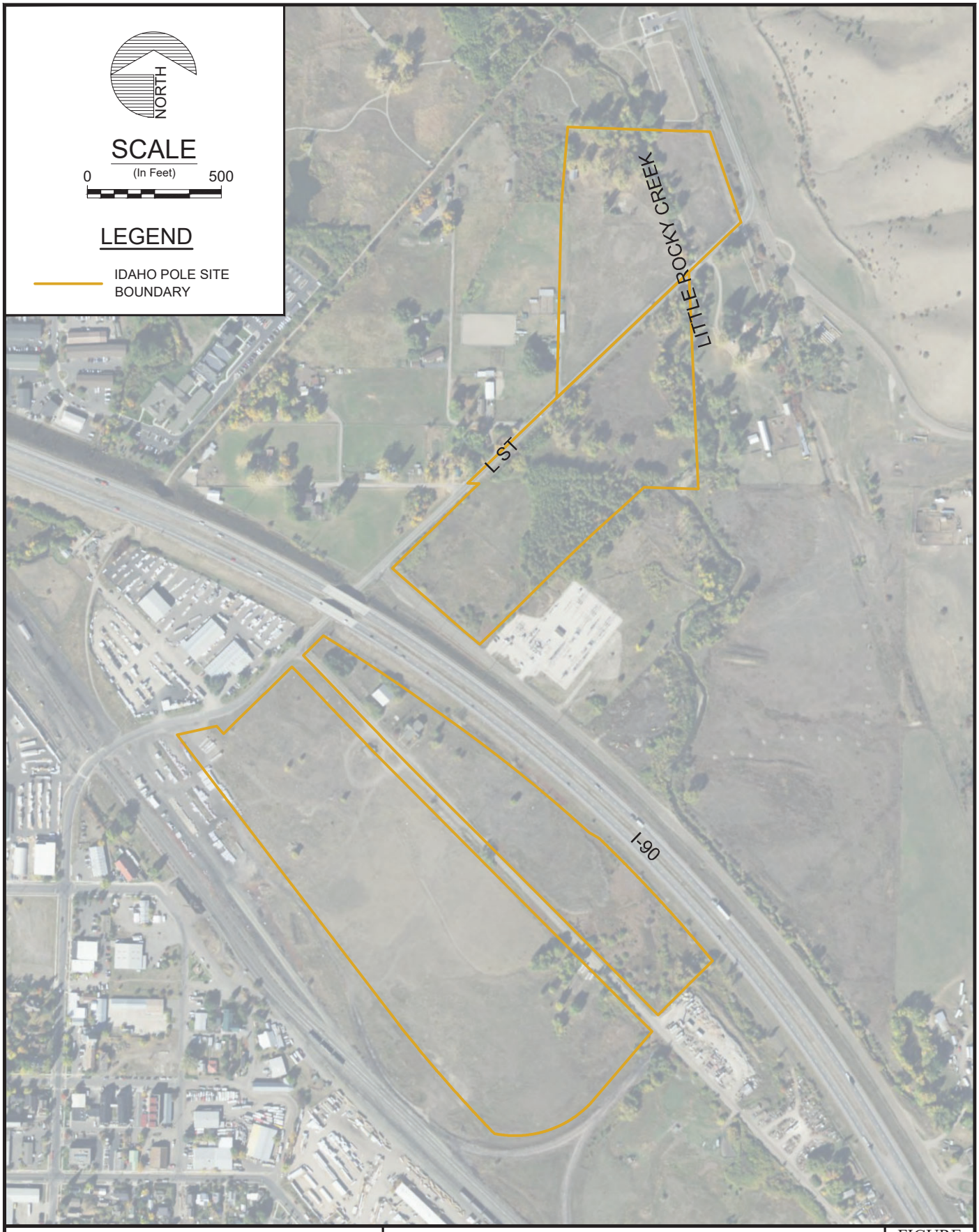
Table 1-2.

Project Schedule and Deliverables

Idaho Pole Company Site

In Situ Amendments and Performance Monitoring in Support of Focused Feasibility Study

Deliverables		Month												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Work Plan Preparation	X													
Design Sampling	X													
Contracting		X												
Set-Up/Preparation		X												
In Situ Amendments			X	X										
Component 1 Final Report Writing, Review and Approval				X	X	X								
Performance Monitoring Component 2				X			X			X			X	
Component 2 Progress Report Preparation, Review and Acceptance						X	X			X	X			
Component 2 Interim Report Preparation, Review and Acceptance												X		
Revised Work Plan Preparation, Review and Approval													X	X



IDAHO POLE COMPANY
BOZEMAN, MONTANA
5029-300

IDAHO POLE SITE

FIGURE
1-1

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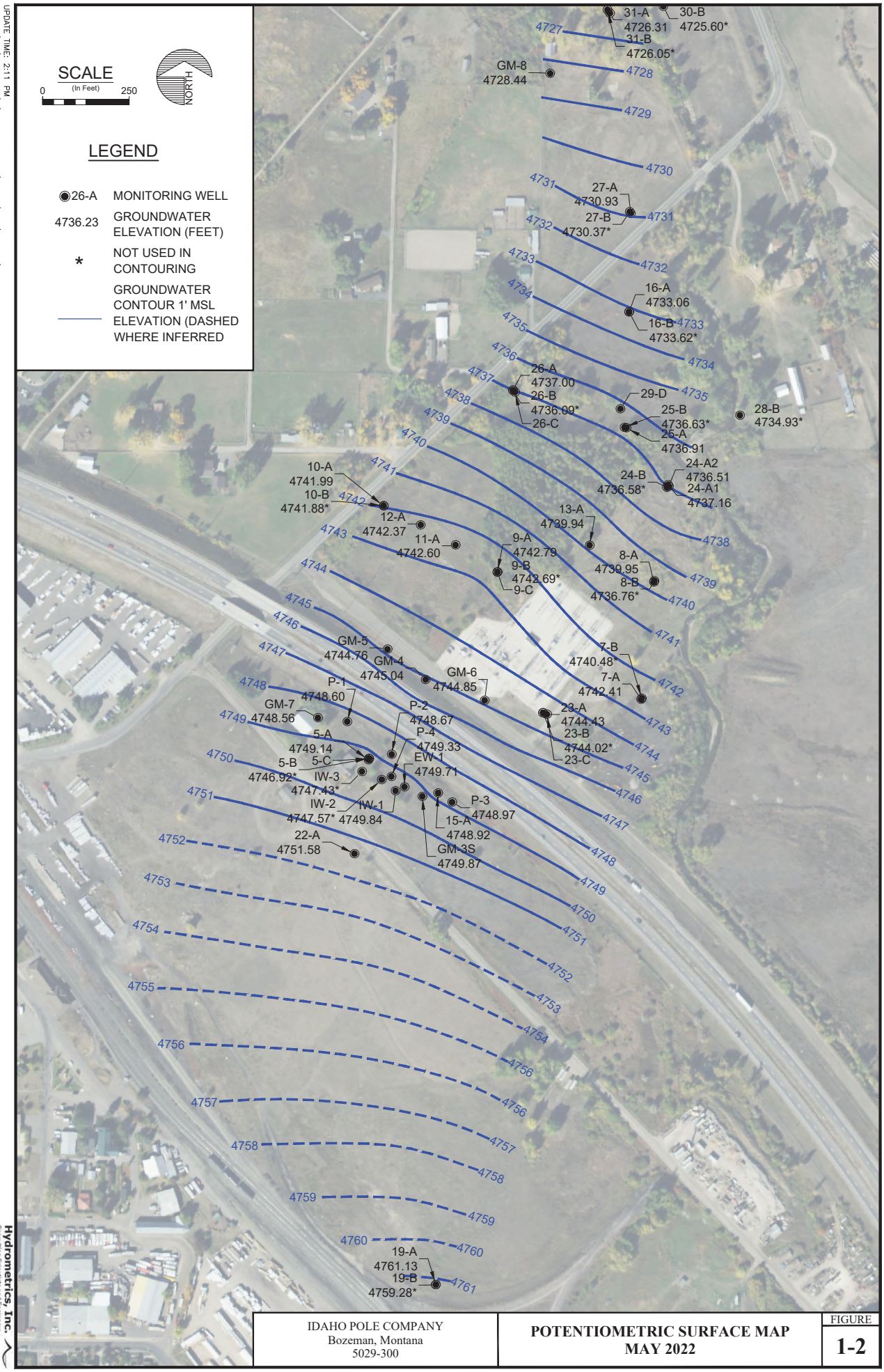
Hydrometrics, Inc.
Consulting Scientists and Engineers



IDAHO POLE COMPANY
Bozeman, Montana
5029-300

POTENTIOMETRIC SURFACE MAP
MAY 2022

FIGURE
1-2

Hydrometrics, Inc.
Consulting Scientists and Engineers

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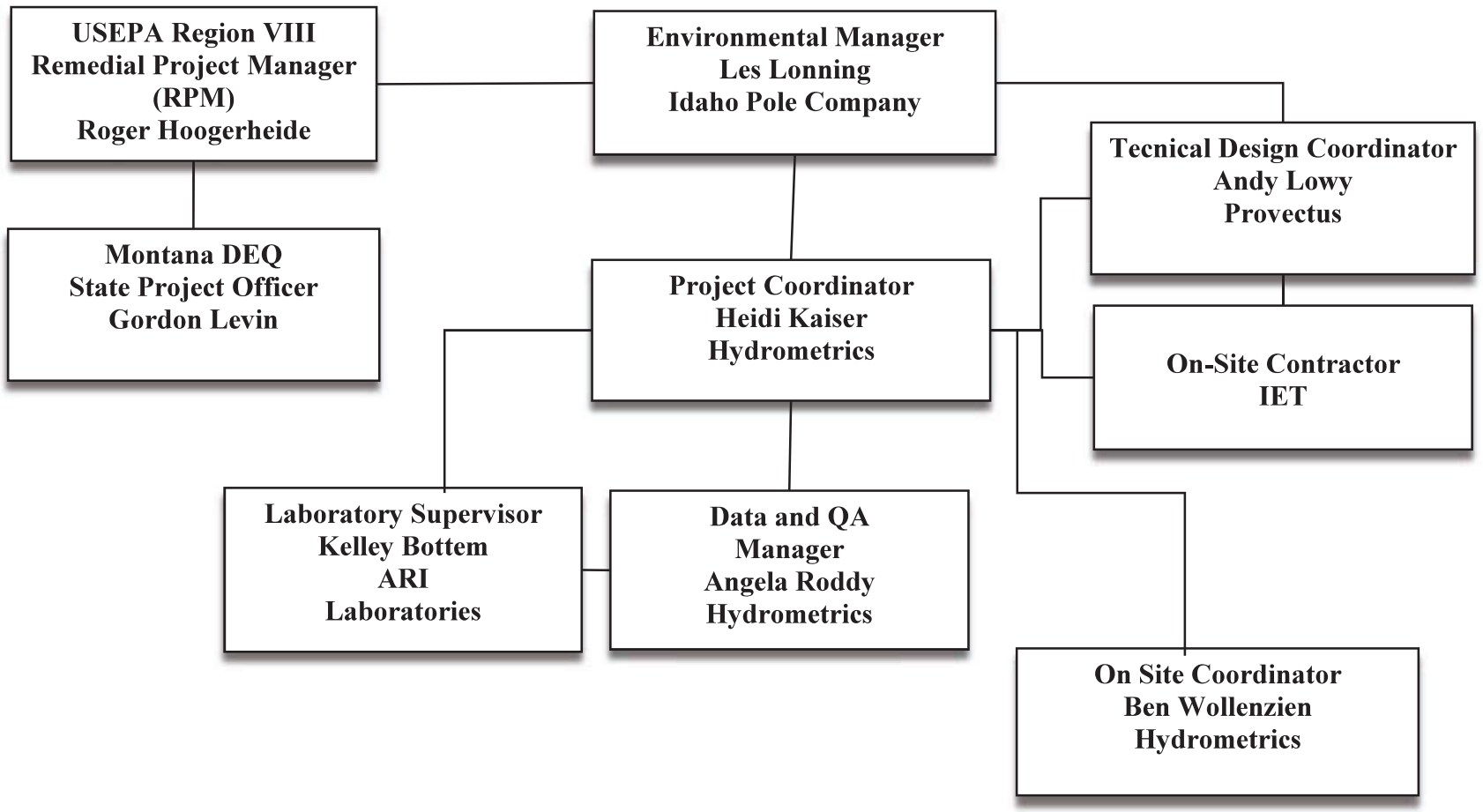


Hydrometrics, Inc.
Consulting Scientists and Engineers

IDAHO POLE COMPANY BOZEMAN, MONTANA	ORGANIZATIONAL CHART	FIGURE 1-3

2. Site Background and Setting

2.1. Site Background

In 1992, EPA selected a remedial alternative for the Site in a Record of Decision (ROD). The ROD identifies the following contaminants of concern (COCs): pentachlorophenol (PCP), polycyclic aromatic hydrocarbons (PAHs), polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (dioxins/furans). EPA designated one Operable Unit (OU01) for the Site that included soil, sediment and groundwater components. On August 26, 1993, EPA issued a Unilateral Administrative Order ("UAO") requiring that IPC implement the Remedial Design/Remedial Action ("RD/RA") process. EPA became the lead oversight agency for the PRP-lead RD/RA at that time, with MDEQ as the support agency.

In 1996, IPC began implementing the groundwater remedy with construction of the Groundwater Recovery System (GRS). With completion of GRS construction in 1997, IPC began groundwater treatment. Groundwater was extracted and treated via granular activated carbon filtration. Nutrients were added to the treated water before it was injected downgradient and upgradient of the source area south of I-90. Between 1997 and 2016, the GRS treated approximately 625 million gallons of impacted groundwater, with no exceedances of PCP or PAH cleanup levels detected in the effluent (Hydrometrics, 2019).

Pursuant to the EPA-approved "In-situ Enhanced Biodegradation Pilot Study Work Plan," IPC installed three groundwater wells and six boreholes in the Bark Fill Area during 2014 (Hydrometrics, 2014). The same year, IPC completed eighteen more boreholes. This work was completed as part of a pilot study to evaluate two methods of oxygen delivery to enhance aerobic degradation of PCP in groundwater in the Bark Fill Area. Results identified impacts to soil material present in the Bark Fill Area with pockets of non-aqueous phase liquid (NAPL) impacted soils generally occurring at or just below the water table (Hydrometrics 2015).

In 2015, IPC conducted a pilot study to inject nitrate-rich nutrients (CBN™) in the Bark Fill Area. The study used the existing GRS with a modified nutrient metering system. The objective of the study was to evaluate aerobic and anaerobic biodegradation of PCP and residual diesel-range petroleum hydrocarbons (PHCs) by providing additional food source for bacteria in the areas where the highest concentrations of PCP and PHC impacts are observed in groundwater. In 2015, IPC initiated the study with injection of additional CBN™ (NutriMax™) nutrients into the Bark Fill injection gallery. Over approximately eight weeks, IPC injected a total of 4,000 lbs of CBN™. Monitoring of a select subset of wells was conducted for the parameters and frequency outlined in the *Pilot Scale Test – Nitrate-Rich Nutrient Injection –Revised Work Plan* (ETEC, LLC June 18, 2015).

In 2016, as part of a second phase of the Pilot Study test to enhance degradation of PCP, IPC injected CBN™ and a non-ionic/biodegradable surfactant (PetroSolv™) into the Bark Fill injection gallery, temporary injection wells, and through direct push boreholes. The CBN™ provided additional food source for bacteria in the areas where the highest concentrations of PCP and PAH impacts were present in groundwater. The surfactant was intended to provide maximum contact and enhance mobilization of sorbed organic constituents. Injection continued for a week, with a total of 7,000 pounds of CBN™ and 385 gallons of surfactant delivered. In situ amendments of the same working solution via direct push boreholes was subsequently performed. After the injection of the working solution was complete, the

GRS system continued to run until December 12, 2016 with injection of treated water only occurring through the Bark Fill injection gallery (Hydrometrics, 2017).

In 2019, IPC prepared a draft FFS report that summarizes the development and screening of remedial alternatives and the detailed analysis of alternatives (Hydrometrics, 2021). Identification and selection of the preferred alternative are reserved by EPA, in consultation with MDEQ.

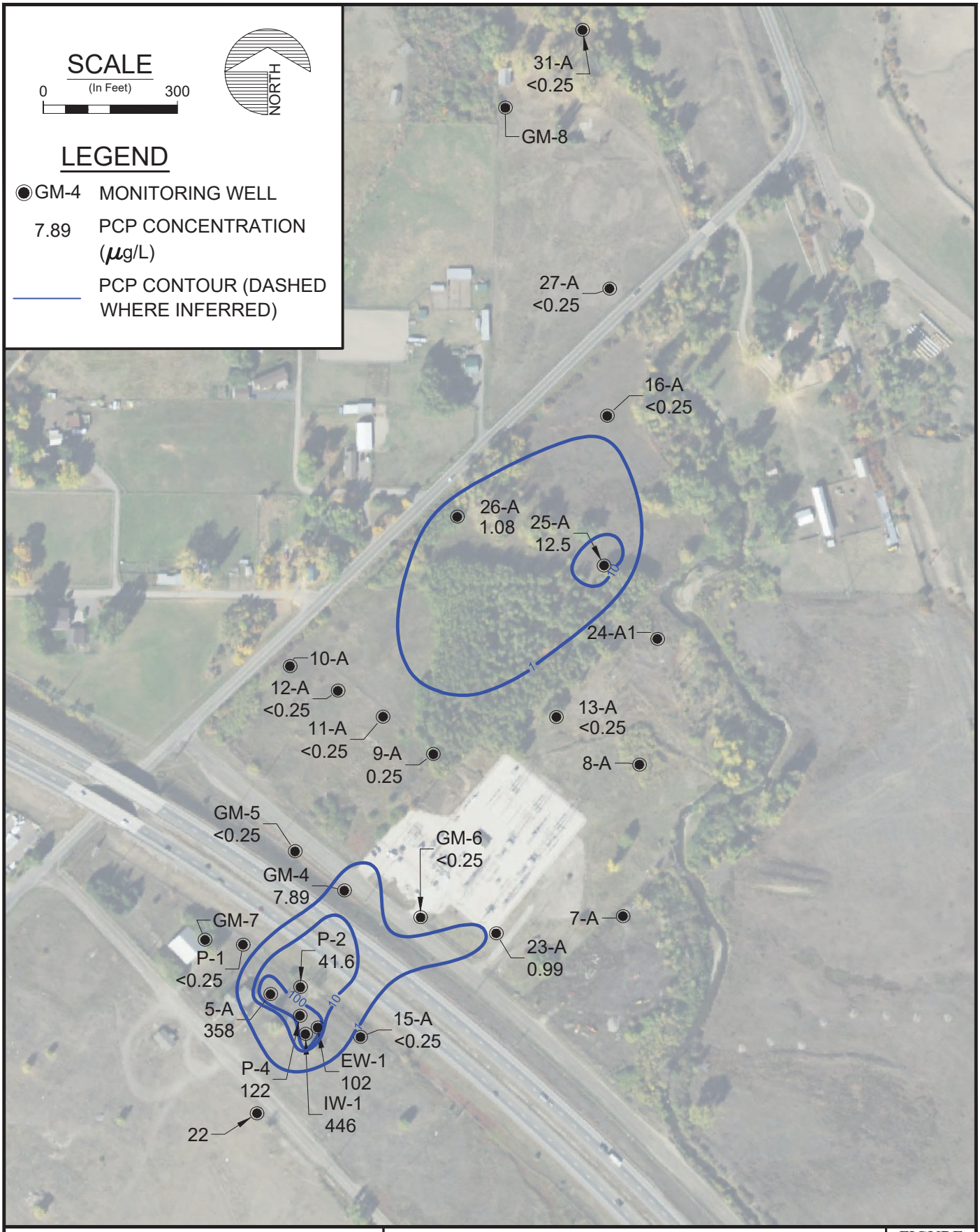
2.2. Hydrogeologic Setting

According to the ROD, there are several delineated stratigraphic intervals at the Site, including a surficial clay horizon ("A" interval), an intermediate silt horizon at 25 feet below ground surface (bgs) ("B" interval), a silty clay horizon at 35 feet bgs ("C" interval), and another silty clay horizon at 50 feet bgs ("D" interval) (MDHES 1992). Intervening aquifers are composed of transmissive sands and gravels, through which groundwater can travel horizontally. The ROD states that the horizons are of variable thickness and permeability and are generally continuous (but probably not continuous over the entire Site). Most of the monitoring locations consist of clustered wells screened at different depth intervals to address the presence of different horizons. Wells are classified as "A" (shallow), "B" (intermediate) or "C" (deeper) with at least one well developed in the "D" horizon. The Remedial Investigation (RI) concluded that there was some hydraulic connection between these different intervals based on hydraulic testing results (MSE 1992).

Groundwater elevation at the Site is generally within 12 feet of ground surface. During periods with high recharge, water levels can reach ground surface in the southeast portion of the Pasture Area. Potentiometric surface maps in recent reports have been developed using water level measurements at shallow wells, and these maps illustrate that groundwater consistently flows to the northeast throughout the year. Water levels are typically highest in the spring, but the general groundwater flow pattern is similar throughout the year.

2.3. Site Contaminants

As described above, the COCs identified in the ROD for soils, sediment and groundwater are PCP, PAHs, and dioxins and furans (MDHES 1992). The PCP was historically dissolved in a carrier fuel similar in consistency to a diesel range organic with a carbon fraction between C_{10} and C_{28}. PAHs are typically associated with the carrier fuels and can be used as indicator constituents for the carrier fuel that has undergone weathering while dioxins and furans normally form in the incomplete combustion during PCP manufacturing. The primary groundwater COC treated by the remedy is PCP, with sporadic detections of PAHs and polychlorinated biphenyls that appear to be limited to the Bark Fill Area. **Figures 2-1 and 2-2** include the extent of PCP in groundwater for "A" wells (shallow) and "B wells (intermediate) taken in fall 2021 (Hydrometrics January 2022).



IDAHO POLE COMPANY
Bozeman, Montana
5029-300

PCP ISOCONTOURS IN "A" WELLS
FALL 2021

FIGURE
2-1

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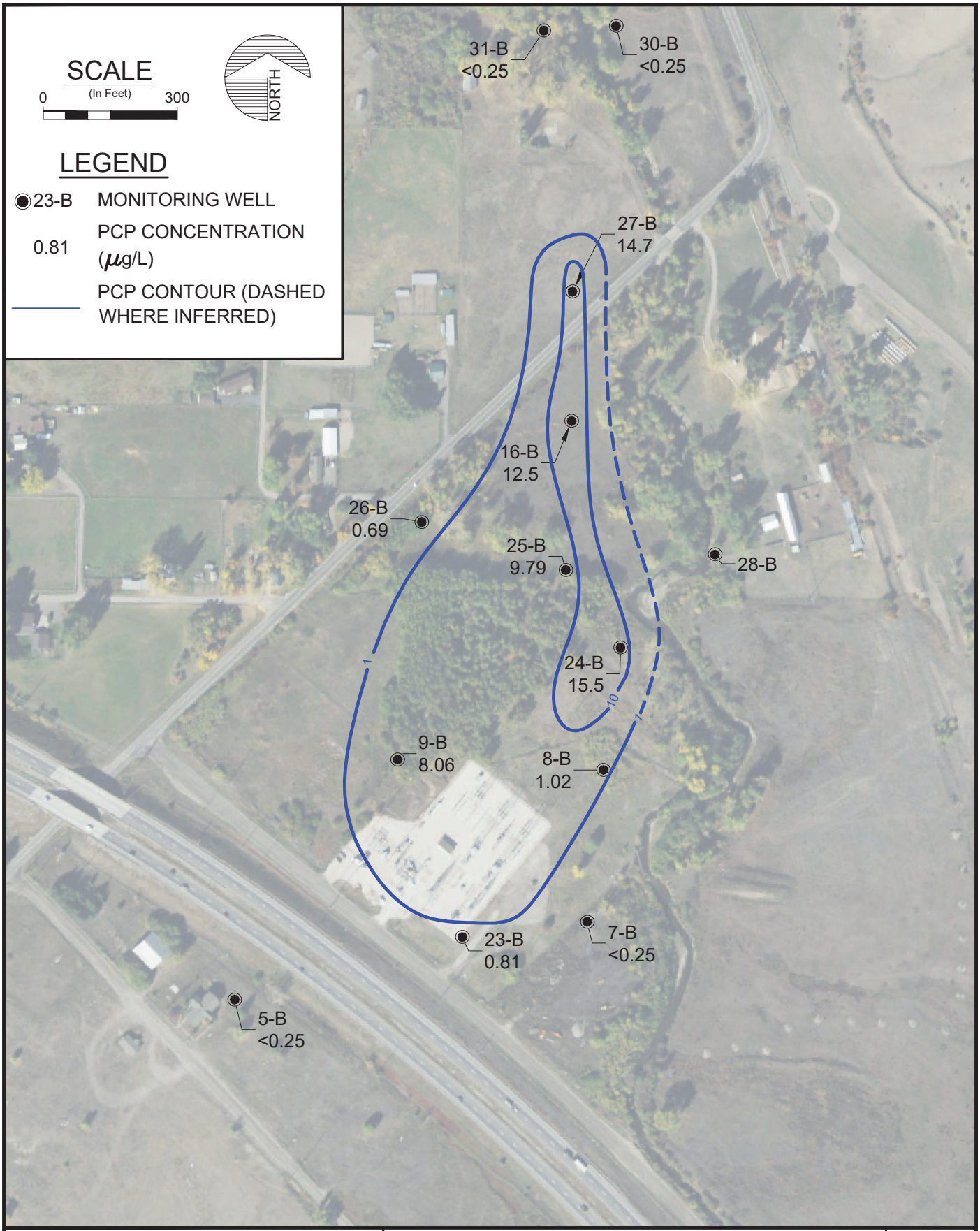

IDAHO POLE COMPANY
Bozeman, Montana
5029-300

PCP ISOCONTOURS IN "B" WELLS
FALL 2021

FIGURE
2-2

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Hydrometrics, Inc.
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3. Work to be Performed

3.1 Conceptual Model of the Potential Hazard

The Site is impacted by historic wood treating activities. Elevated concentrations of wood treating fluids have been identified during previous sampling events and have been identified as potentially having an adverse impact on the receiving groundwater environment. The primary source of COCs in soil and groundwater at the Site is the residual wood treating fluids that resulted from releases during wood treating operations. These fluids were transported by gravity to subsurface soils and aquifer materials where these fluids can accumulate as light non-aqueous phase liquid (LNAPL) on the groundwater surface or dissolved in the water. The high groundwater flux in the sands and gravels in the "A" and "B" intervals further mobilized these fluids downgradient. These fluids have also been distributed within the aquifer smear zone as the water table fluctuates seasonally. Recent borings collected in the Bark Fill Area in 2014 indicate that emulsified droplets and stains of wood treating fluids occur in isolated pockets in the smear zone as it became trapped by heterogenic deposits of soil and aquifer materials.

Residual wood treating fluids were also observed in the Bark Fill Area during investigations conducted in preparation of the 2015 and 2016 in-situ treatment pilot tests. A bark fill chip layer was encountered at depths of 5 to 15 feet bgs and extended a few feet into the gravels and cobbles as well into the smear zone above but did not extend into the fine-grained unit below the gravel. Residual wood treating fluid occurred as droplets between 11 and 14 feet bgs in sand and fine gravels at five boreholes. A hydrocarbon sheen and staining were observed on soil cores removed from an additional six boreholes from 7 to 18 feet in depth. The extent of residual smear zone impacts has been inferred based on groundwater sampling conducted during the enhanced biodegradation pilot tests as well as observations made during modifications to GRS operations between 2009 and 2016. Reduction of the LNAPL footprint over time is a result of soil removal during the soil remedy, GRS operation from 1997 through 2016, pilot tests in 2015 and 2016 as well as natural processes including microbial degradation of the oily wood treating fluids. Based on these data, a measurable layer of wood treating fluid at the groundwater surface also likely no longer exists south of I-90 in the Bark Fill Area making this area an ideal candidate for in situ amendments.

Groundwater chemistry data collected from 1999 through 2021 demonstrate trends of decreasing PCP/PAH concentrations within and downgradient of source areas and shrinking of the PCP/PAH plume by approximately 80 percent, evidencing decreasing mass of PCP/PAH in groundwater. Furthermore, PCP mass in Site groundwater was estimated in 2009 (GSI Environmental, 2009) (USEPA-542-R-09-004) and more recently in 2020 (Hydrometrics, 2021). Modelling was utilized during both efforts to estimate yearly PCP mass along a line of wells immediately north of I-90 along Bohart Lane using groundwater analytical results. Based on those analyses, estimated PCP mass has decreased from 32.9 kilograms (kg) in 1998 to 2.12 kg in 2007 to 0.41 kg in fall 2019. Statistical comparisons of yearly PCP mass estimates indicate a decreasing trend since 1998. Given the limited mass flux in this area, a PRB is an appropriate in-situ treatment approach to consider immediately north of I-90. Typically, a PRB is made of reactive materials and is placed under the surface where the dissolved contamination plume is allowed to flow through the permeable barrier. Treated water then exits the other side of the PRB.

Transient pulses of PCP concentrations have been observed and may be related to seasonal fluctuations of the water table and increased infiltration during precipitation and snowmelt events. These pulses

generally appear to flush through the system quickly due to the fast groundwater velocity at the Site. Pulses of relatively higher magnitude have been observed recently and may be attributed to greater than typical snow melt as well as prolonged precipitation events that occurred during spring and summer. These pulses are particularly evident at downgradient boundary wells (25-B and 27-B). Additional PRBs, as depicted on **Figure 3-1**, are an appropriate technology to implement to prevent further migration of the dissolved phase PCP plume.

3.2 Available Resources, Constraints and Deadlines

IPC has identified the Project Team and determined resources required and a tentative schedule for Component 1 of this Work Plan. The in situ amendments are expected to take one and a half to two months to inject once amendments have been delivered to the Site and the subcontractor has mobilized to the Site; followed by 2 months to write, review and approve a final report. The timeframe for injecting amendments is based on two direct push rigs operating simultaneously on a 10 days on and 4 days off schedule. It is anticipated that there will be approximately 435 injection points in total with two to six injection intervals per point. Potential constraints that could delay field work include, but are not limited to, contracting delays, adverse weather conditions, equipment malfunction, tight lithology that limit how fast amendments can be injected and property access issues. If in situ amendments, in part or in whole, cannot be injected due to any constraints at any point, this will be recorded in the field logs and reported verbally as soon as possible to the EPA Remedial Project Manager. If the project schedule needs to be modified due to these unforeseen delays, IPC is required to seek a schedule modification approval from EPA.

The Project Team, necessary resources required and a tentative schedule for the first nine-months of Component 2 of this Work Plan have also been identified. Three planned quarterly groundwater monitoring/sampling events are each expected to take seven to ten days for sample collection; two to three weeks for laboratory analysis; followed by 30 days after validation of laboratory data to write and review progress reports. The timeframe for sample collection is based on one Hydrometrics technician measuring water levels at all Site wells and collecting samples from 31 monitoring wells during each event with the addition of eight residential wells included in the fall 2022 event as outlined in Section 6.0. Potential constraints that could delay sample collection and laboratory analysis include, but are not limited to, adverse weather conditions, equipment malfunction, shipping delays and property access issues.

3.3 Goals and Objectives

The goal of the in situ amendments is to inject ISCO reagents into the Bark Fill Area and mid-plume permeable reactive barrier areas and in situ chemical reduction (ISCR) reagents in further downgradient permeable reactive barrier to address the remaining wood treating fluids that continue to source a groundwater plume. The Remedial Action Objective (RAO) is to remediate the source area and downgradient plume with Provect-OX®, Provect-OX2™, and Provect-IR®, which will remediate soil and groundwater and expedite natural attenuation. To reach the RAO, the in situ amendments will be applied via approximately 435 direct push injection points throughout the targeted treatment areas. Provect-OX® is proposed for rapid, permanent reduction of PCP and PAHs in the high concentration Bark

Fill Area. Provect-OX2™ is proposed as a long-term *in situ* chemical oxidation PRB to prevent further migration of the source area. By products of the Provect-OX® and Provect-OX2™ reactions in groundwater include water, carbon dioxide, sulfate and iron. Provect-IR® is proposed as a solid, long-term remedial option to promote biotic and abiotic conditions to establish further downgradient control of the PCP plume. By products of the Provect-IR® reactions in groundwater include water, carbon dioxide, ethene and ethane. The remedial programs are designed to be conducted concurrently during a single injection event. Relevant case studies from other sites are included in **Appendix A**.

The goal of the performance monitoring is to evaluate the effectiveness of the in situ amendments and guide the scope of the 7 years of groundwater monitoring under Component 2.

3.3.1 Boundaries of the Study

The boundaries of the study area are the Site boundaries depicted on **Figure 1-1** which include the Controlled Groundwater Use Area. The statistical population of interest for this project consists of the aqueous chemical and physical parameters that will receive in situ amendments during summer/fall of 2022 and which will undergo treatment. Resulting data collected from well monitoring network as part of Component 2 of the ASAOC will monitor the effectiveness of in situ amendments over a seven-year period. The current well network allows for monitoring of the shallow, mid and deeper water bearing zones in the source area as well as in downgradient areas, as such, these monitoring wells define the lateral and vertical extents of the plume. Analytical data will be verified and evaluated as they are received by reviewing field and laboratory quality controls and comparing results to prior COC concentrations.

If at any time during Component 2 performance monitoring EPA determines it is necessary to implement Components 3 and 4, EPA will notify the Respondent in writing that those Work Plans are required under the ASAOC. The Respondent must provide a Revised Work Plan that addresses Components 3 and 4 within 45 days of receiving EPA's notification.

3.3.2 Bark Fill Area

Due to the presence of PCP and PAHs in the Bark Fill Area, IPC is proposing to implement a large scale Provect-OX® application. Provect- OX® is an ISCO/ enhanced bioremediation reagent that uses ferric iron (Fe III) as a safe and effective means of activating reactants. Provect- OX® oxidizes a wide variety of organic compounds present in impacted soil, sediment and groundwater, including chlorinated solvents, petroleum hydrocarbons, and pesticides. In situ injections will focus on a 26,000 square foot (sq ft) area (**Figure 3-1**) with a vertical treatment interval from approximately 4 to 21 feet below ground surface (ft bgs). The vertical treatment interval will be split into shallow (4-10 feet) and deep (10-21 feet) zones based on varying results from the total oxidant demand (TOD) tests that were conducted. Based on the data provided for the shallow zone, the remaining wood treating fluid impacts in the 26,000 sq ft area represent 80 lbs of mass, which have an oxidant demand of 1,600 lbs of Provect-OX®. For total reagent mass calculations, a soil oxidant demand (SOD) of 7.0 grams (g) Provect-OX® per kilogram (kg) soil was used based on soil boring logs, potential for high organic matter and results from the TOD tests. This represents an additional demand of 118,400 lbs Provect-OX® for a total of 120,000 lbs Provect-OX® for the shallow zone.

Based on data provided for the deep zone, the residual wood treating fluid impacts represent 145 lbs of mass, which have and oxidant demand of 2,950 lbs of Provect-OX ®. For total reagent mass calculations,

a SOD of 2.25 g Provect-OX® per kg soil was used based on soil boring logs and results from the TOD tests. This represents an additional demand of 72,050 lbs Provect-OX® for a total of 75,000 lbs Provect-OX® for the deep zone.

Tables 3-1a and **3-1b** outline the individual oxidant demands and injection details for the Bark Fill Source Area for the shallow (4-10 foot deep) and deep (10 to 21 ft deep) zones. Amendments will be mixed with water at about a 50/50 mixture and applied as a liquid through 300 direct push injection points at 9-10 foot spacing. Subsurface soils are anticipated to be penetrated with a direct push probe, but not brought to the surface. Boreholes are also anticipated to be plugged and capped after treatment completion.

Table 3-1a: Shallow Source Area Provect-OX® Mass Requirements

Treatment Area	26,000 sq ft
Treatment depth (4 to 10 ft bgs)	6 ft
Treatment Volume	156,000 ft3
Soil Density and Mass of Soil to Treat	8,580 tons
SOD	7.0 g Provect-OX® / kg soil
Provect-OX® Demand from COI	1,600 lb
Provect-OX® Demand from SOD	118,400 lb
Total Provect-OX®	120,000 lb
Total Water Volume	56,500 gallons
Number of Injection Points	300 Points (≈ 9-10 ft spacing)
Number of Vertical Interval Intervals	600 Intervals (2 intervals per point)
Provect-OX® per Point with Required Water	400 lbs of Provect-OX® + 190 gallons of water

Table 3-1b: Deep Source Area Provect-OX® Mass Requirements

Treatment Area	26,000 sq ft
Treatment depth (10 to 21 ft bgs)	11 ft
Treatment Volume	286,000 ft3
Soil Density and Mass of Soil to Treat	15,730 tons
SOD	2.25 g Provect-OX® / kg soil
Provect-OX® Demand from COI	2,950 lb
Provect-OX® Demand from SOD	72,050 lb
Total Provect-OX®	75,000 lb
Total Water Volume	69,000 gallons
Number of Injection Points	300 Points (≈ 9-10 ft spacing)
Number of Vertical Interval Intervals	900 Intervals (3 intervals per point)
Provect-OX® per Point with Required Water	250 lbs of Provect-OX® + 230 gallons of water

Distribution of the reagents will be qualitatively monitored during injection in the Bark Fill Area by visual inspection of water extracted from nearby wells and field measurements using a YSI multimeter in accordance with HF-SOF-108 (Appendix C). These wells include monitoring wells and former extraction

and injection wells located in the Bark Fill Area as show on **Figure 3-1**. Water will be extracted by bailing or pumping the well. The reagent is red when dissolved in water and will be visible in water to the naked eye under normal lighting conditions. Specific conductivity measurements will also be used as a guide. All observations will be recorded in the field notebook. Water purged from wells will be disposed on the ground surface.

3.3.3 Downgradient Barriers

Mid-Plume Provect-OX2™ Treatment Program: Directly north of I-90, a mid-plume permeable reactive barrier (PRB) will be implemented to stunt the progression of the PCP and PAH plume using Provect-OX2™. Provect-OX2™ has the same chemistry and advantages associated with Provect- OX® with potassium persulfate added to the reagent blend to extend the ISCO lifespan. Provect- OX2 ™ is ideally suited to address significantly impacted sites, addition to excavations, and creation of permeable reactive barriers. The in situ amendments will focus on a 500 ft long PRB (**Figure 3-1**) with a vertical treatment interval from approximately 3 to 21 ft bgs. The vertical treatment interval will be split into shallow (3-10 feet) and deep (10-21 feet) zones based on varying results from the TOD tests that were conducted.

Based on the data provided for the shallow zone, the remaining wood treating fluid impacts represent 35 lbs of mass, which have an oxidant demand of 725 lbs of Provect-OX2 ™. For total reagent mass calculations, a SOD of 6.0 g Provect-OX2® per kilogram (kg) soil was used based on soil boring logs, potential for high organic matter and results from the TOD tests. This represents an additional demand of 44,475 lbs Provect-OX® for a total of 45,200 lbs Provect-OX2 ™ for the shallow zone.

Based on data provided for the deep zone, the residual wood treating fluid impacts represent 55 lbs of mass, which have and oxidant demand of 1,100 lbs of Provect-OX2 ™. For total reagent mass calculations, a SOD of 2.5 g Provect-OX2 ™ per kg soil was used based on soil boring logs and results from the TOD tests. This represents an additional demand of 32,800 lbs Provect-OX® for a total of 33,900 lbs Provect-OX2 ™ for the deep zone.

Table 3-2a: Shallow Mid-Plume PRB Provect-OX2® Mass Requirements

PRB Length	500 ft
PRB Width	20 ft
Treatment depth (3 to 10 ft bgs)	7 ft
Treatment Volume	70,000 ft3
Soil Density and Mass of Soil to Treat	3,850 tons
SOD	6.0 g Provect-OX2™ / kg soil
Provect-OX2™ Demand from COI	725 lb
Provect-OX2™ Demand from SOD	44,475 lb
Total Provect-OX2™	45,200 lb
Total Water Volume	19,775 gallons
Number of Injection Points	113 Points (2 rows of ≈ 56 points each)
Number of Vertical Interval Intervals	226 Intervals (2 intervals per point)
Provect-OX2™ per Point with Required Water	400 lbs of Provect-OX2™ + 175 gallons of water

Table 3-2b: Deep Mid-Plume PRB Provect-OX2® Mass Requirements

PRB Length	500 ft
PRB Width	20 ft
Treatment depth (10 to 21 ft bgs)	11 ft
Treatment Volume	110,000 ft3
Soil Density and Mass of Soil to Treat	6,050 tons
SOD	2.5 g Provect-OX2™ / kg soil
Provect-OX2™ Demand from COI	1,100 lb
Provect-OX2™ Demand from SOD	32,800 lb
Total Provect-OX2™	33,900 lb
Total Water Volume	29,945 gallons
Number of Injection Points	113 Points (2 rows of 56 points each)
Number of Vertical Interval Intervals	226 Intervals (3 intervals per point)
Provect-OX2™ per Point with Required Water	300 lbs of Provect-OX2™ + 265 gallons of Water

Two additional 75-foot reactive barriers are anticipated to be installed downgradient of the first PRB. The downgradient portion of the plume beyond well 13-A consists of only dissolved phase PCP contamination. Given that the geochemical conditions in this portion of the plume show strongly reducing conditions (negative oxidation reduction potential (ORP) and dissolved oxygen (DO) levels below 1 mg/L) and the lack of PAH contamination, IPC is proposing to implement two PRBs, as depicted on **Figure 3-1**, to prevent further migration of the dissolved phase PCP plume. A Provect-IR® formulation containing 60% zero valent iron (ZVI; Provect-IR60) weight basis (mixed grades) will be used to contain and remove PCP from the targeted zone. Provect- IR® is a unique mixture of reagents combined into a single product that optimizes the *in situ* reductive dechlorination of chemicals present in soil, sediment, and groundwater. It acts by promoting synergistic interactions between:

- Natural antimethanogenic compounds
- Hydrophilic, nutrient rich organic carbon sources
- ZVI
- Chemical oxygen scavengers
- Vitamin and mineral sources

This distinctive, patented combination of natural and food-grade chemicals promotes ISCR conditions for fast and effective destruction of the targeted COCs. Notably, Provect- IR® is the only ISCR reagent to simultaneously inhibit the production of methane during the requisite carbon fermentation processes. This promotes more efficient use of the hydrogen donor while avoiding negative issues associated with elevated methane in groundwater, soil gas, and indoor air.

The 60% ZVI content will manage aquifer pH and maintain remedial efficacy over an extended period of time (e.g., >7 years). The 40% organic content will help further reduce ORP levels and create ISCO conditions. Considering the site conditions, Provect-IR60 will be applied at a rate of approximately 0.40% to soil mass. Details on the two PRBS are outlined in **Tables 3-3** and **3-4** below. The target treatment zone is approximately 4-30 feet. In situ amendments will be applied through direct push injection points in an off-set double row. Subsurface soils are anticipated to be penetrated with a direct

push probe, but not brought to the surface. Boreholes are also anticipated to be plugged and capped after treatment completion.

Table 3-3: 25-A/B PRB - Provect-IR60 Mass Requirements

	Value
Area of Concern Dimensions:	
Barrier Length (ft)	75 ft
Barrier Width (ft)	20 ft
Depth to top of vertical treatment interval (ft)	5 ft bgs
Depth to bottom of vertical treatment interval (ft)	32 ft bgs
Thickness (ft)	27 ft
AOC volume (ft3)	2,025 ft3
Mass of soil in PRB (US Tons)	2,228 US Tons
Percentage Provect-IR by soil mass	~0.40
Mass of Provect-IR required (lbs)	16,800 lbs
Total Water Volume	8,640 gallons
Number of Injection Points	16
Number of Vertical Interval Intervals	96 (6 per point)
Mass of Provect-IR and Water Volume per Point	1,050 lbs + 1,440 gallons of water

Table 3-4: 27-B PRB - Provect-IR60 Mass Requirements

	Value
Area of Concern Dimensions:	
Barrier Length (ft)	75 ft
Barrier Width (ft)	20 ft
Depth to top of vertical treatment interval (ft)	27 ft bgs
Depth to bottom of vertical treatment interval (ft)	32 ft bgs
Thickness (ft)	5 ft
AOC volume (ft3)	375 ft3
Mass of soil in PRB (US Tons)	413 US Tons
Percentage Provect-IR by soil mass	~0.40
Mass of Provect-IR required (lbs)	3,600 lbs
Total Water Volume	1,584 gallons
Number of Injection Points	6
Number of Vertical Interval Intervals	12 (2 per point)
Mass of Provect-IR and Water Volume per Point	600 lbs + 264 gallons of water

Distribution of the reagents in the down gradient barrier areas will be monitored during injection by visual inspection of water extracted from nearby wells along Bohart Lane (GM-4, GM-5, GM-6) and at 25A/B and

27A/B as shown on **Figure 3-1**. Water will be extracted for observation and measurement of field parameters by bailing or pumping the wells. The reagent is red when dissolved in water and will be visible in water to the naked eye under normal daylight conditions. Specific conductivity measurements will also be used as a guide. All observations will be recorded in the field notebook. Water purged from wells will be disposed on the ground surface.

3.4 Equipment, Supplies, and Materials

This section details the critical supplies that are needed for implementation of the in situ amendments (Component 1) and performance monitoring (Component 2) in support of the FFS. This list has been compiled for planning purposes. Actual construction and monitoring materials may be subject to change. Ms. Heidi Kaiser is in charge of equipment procurement, testing, inspection before usage, and maintenance. She will ensure that all equipment, material and supplies procured for construction and ongoing maintenance (e.g., spare parts) and monitoring are of acceptable quality by conducting source inspections and supplier audits. Quality assurance will be achieved through appropriate source selection and examination of deliverables.

Component 1 Field Equipment and Supplies

- 2 - Direct push injection set ups that includes Power Probes and support trailers with mixing tanks, injection pumps, compressors, flowmeters, eye wash stations, etc.
- Global Positioning System for survey of treatment areas
- 20,000 gallon water storage tanks with associated pumps and hoses to fill mixing tanks.
- Water truck or trailer for filling water storage tanks
- Assorted hand tools (wrenches, screwdrivers, etc.)
- Appropriate Personal Protection Equipment (PPE) as outlined in the Site Specific Health and Safety Plan (HASP) included in Appendix B
- 5% Alconox solution for decontaminating equipment
- Decontamination buckets, tubs and brushes
- 55-gallon drums and labels for decontamination water storage
- Gallatin County waste disposal bin
- Disposable poly bailers with rope and/or a peristaltic pump and tubing for extracting water from existing wells in treatment areas for observations of water color and clarity and for measurement of field parameters, include SC, pH and turbidity.
- Electronic water level meter
- Field meters for monitoring specific conductivity, pH and water temperature.
- Turbidity meter
- SC, pH and Turbidity Standards
- Clear sample jars for observing extracted water
- Orange plastic fencing and steel posts for temporary fencing of work areas.
- Field books and field forms
- SAP and HASP
- Camera and white board
- Nitrile gloves

- Paper towels
- Trash bags

Component 2 Equipment and Supplies

- Well Keys
- PPE
- SAP and HASP
- Electronic water level meter
- Field meters for monitoring specific conductivity, pH, ORP, DO and water temperature.
- SC and pH Standards
- Peristaltic Pump and tubing
- Laboratory supplied coolers and bottles
- Ice for sample preservation
- Reagent grade water for blanks
- Chain of Custody (COC) forms, pens and markers
- Field books and field forms
- 5 gallon buckets
- Nitrile gloves
- Paper towels
- Trash bags
- Extra batteries for field meters

All field equipment calibration and maintenance activities will be conducted in accordance with manufacturer's specifications, user's manual, and applicable SOPs. Calibration and maintenance activities will be documented in a logbook dedicated to each piece of equipment. Logbook entries will be signed and dated by the individual performing calibration or maintenance, or the individual responsible for coordination (such as the field task lead) if equipment is shipped to a manufacturer for repair or maintenance. Logbooks will be stored with the appropriate piece of equipment.

Transportation of the amendments to the Site will be completed using a Department of Transportation-certified, commercial hauling company under chain-of-custody. Amendments will be stored within the secured fenced former groundwater treatment enclosure as shown on Figure 3-2 until ready for use.

A water source will be secured by Hydrometrics to mix with the in situ amendments. The water source will be a private well located approximately 2500 feet southeast of the Site. Water will be delivered to the Site with a water truck and transferred to the on-site water storage tanks via pump and hoses.

3.4.1 Acceptance Requirements for Supplies and Consumables

The Hydrometrics Project Coordinator or their designee will identify critical supplies and consumables for the field, documenting supply source, acceptance criteria, and procedures for tracking, storing and retrieving materials. All supplies will be in satisfactory condition as a prerequisite to being used on the project and will be stored on Site in the secured fenced former groundwater treatment enclosure prior to use.

3.5 Mobilization/Demobilization

Mobilization activities are directed by the Hydrometrics Project Coordinator and their designee. All contractors and associated personnel will be briefed on the scope of work outlined in this Work Plan and requirements. Some mobilization activities may be required prior to commencement of injections, including site control and receiving and storing amendments, and receiving and filling water storage vessels.

Upon completion of the proposed work associated with Component 1, all equipment, materials, and supplies will be demobilized from the Site. In accordance with the *Soils Management Plan (Hydrometrics, 2011)*, construction equipment, vehicles, PPE, and other items that come into contact with contaminated soils in the treated soils area or saturated soils within the controlled groundwater area must be cleaned and washed before leaving the Site to prevent migration of contamination to public streets. The wash water must be contained and either treated on-site or sampled and properly disposed. A designated-decontamination area will be established with approval from EPA at the onset of field activities. Agency approval will be documented in the field logbook.

3.5.1 Site Controls

Surface water run-on and run-off must be controlled to prevent contaminated soil or water from leaving the work area consistent with Montana Pollutant Discharge Elimination System requirements for construction projects. Idaho Pole's contractor (Hydrometrics) will implement engineering controls and best management practices to protect against off-site migration of contaminated water and soil via runoff from rain events and/or vehicles and equipment working at the Site. Controls may include silt fencing, track-out best management practices, equipment/vehicle decontamination areas, etc. Dust control measures will be implemented to reduce dust generation and prevent off-site migration of visible dust, if needed. The only likely source of fugitive dust will be from water haul truck traffic on Cedar Street and Bohart Lane. To prevent dust generation on these public streets during dry weather, the water truck will soak the street where work is occurring each morning and during the day as needed.

Access to the Site during disturbance of soils at or below 12-inches in the designated area must be restricted to authorized workers and agency personnel and entryways must be monitored. Hydrometrics will be responsible for providing vehicular and foot traffic control (e.g., temporary fencing, orange perimeter fencing) to restrict access to the Site including any traffic control and encroachment permits required by the City of Bozeman.

All personnel working on the Site during the in situ injections will comply with the Site Specific Health and Safety Plan that is included in **Appendix B**. A copy will also be available in support trailers.

3.5.2 Abandonment of Monitoring Wells

It is assumed that no monitoring wells or groundwater injection/extraction points within the Source Treatment area north of Cedar Street will need to be abandoned prior to construction activities associated with Component 1 or performance monitoring activities associated Component 2. Should monitoring wells need to be abandoned, IPC will identify wells in a well abandonment work plan. Wells will be abandoned in accordance with appropriate state of Montana regulations and with the approval of the Agencies.

3.6 Equipment Decontamination

Equipment decontamination is an important task in the implementation of in situ amendments. Decontamination procedures are outlined in the SOPs (**Appendix C**) that accompany this workplan and will be strictly followed throughout this investigation. All downhole equipment that comes in contact with contaminated soil or groundwater must be cleaned and washed before leaving the Site and between injection areas to prevent migration of soils to public streets. A decontamination pad will be constructed at each treatment area for cleaning and collection of wash water. The location of these pads will be determined in consultation with EPA and MDEQ at the onset of field work based on equipment layout.

Multiparameter probes and water level probes used to monitor radius of influence of amendments in nearby monitoring wells or for performance monitoring will need to be cleaned between wells.

Aqueous waste generated from equipment decontamination (HSOP-7) will be containerized, characterized, handled, and disposed of in accordance with Waste Management Plan included as **Appendix D**.

3.6.1 Soil and Waste Management

Based on prior experience by Provectus and their contractor, it is not anticipated that any soil will be generated as part of the in situ amendments injections. However, if soil is generated as a result of decontamination procedures, it will be containerized and sampled for Site COC's as directed in the Waste Management Plan (**Appendix D**). If concentrations of PCP are below Site clean up Levels specified in **Table 3-5**, the soil can be reused on Site. If not, the soil will be treated on-site using Provectox products. Note that if any soil is brought to the surface on the direct push tips, it would have been exposed to Provectus products during the injection process destroying any COCs that may have been present.

Incidental/contact waste generated during field activities may consist of spent personal protective equipment and disposable sampling supplies, including: nitrile gloves, Ziploc® bags, amendment packaging, and paper towels. Incidental/contact waste will be bagged and disposed of as municipal waste. A bin for collecting this waste will be staged on Site and taken to the Gallatin County Landfill as needed.

3.6.2 Sample Labeling and Identification

Sample labeling of all investigative derived waste analytical samples (attached to each container) will use a unique sample identifier following the coding system outlined below. These sample identifiers along with the dates collected and other pertinent information (e.g., duplicate pair information, time collected, any sample observations of note, etc.) will be recorded in the Hydrometrics' field logbook at the time of sampling.

Following is the sample identifier coding system:

Example: 22IPIDW01

The year (2022) and site name (i.e., Idaho Pole) and investigative derived waste (IDW) are identified by the first seven characters ("22IPIDW") of the sample identifier. This will be the same for all samples for this project. The remaining characters change based on the sample type and collection point.

The final two characters are numbers which are in the order they were taken ranging from “01” up to “99” and are sequentially generated.

Groundwater samples collected under Component 2 will also use a unique sample identifier following the coding system used for groundwater samples to date

The following is the sample identifier coding system for groundwater samples:

Example: IPC-2205-100

The Site name (IPC), the year (2022) followed by the month (May – 05) and sample number beginning with 100 at the first well and continuing in numerical succession with each sample. These sample identifiers along with the associated well name, date and time of sample collection, and other pertinent information (e.g., duplicate pair information, time collected, any sample observations of note, etc.) will be recorded in the Hydrometrics’ field logbook at the time of sampling.

TABLE 3-5
CLEANUP LEVELS AND CORRESPONDING RISKS
IDAHO POLE COMPANY - BOZEMAN MONTANA

Medium	Contaminant	Cleanup Level	Basis	Cancer Risk (industrial use for soil, residential use for ground water)	Noncancer Health Hazard Quotient
Soils and sediments	PCP	48.0	risk	1.0×10^{-6}	ND[b]
(mg/kg)	Total B2 PAHs	15.0[a]	risk	1.0×10^{-6}	ND
	Total D PAHs	145	hazard	NA	0.1
	TCDD TE*	0.001	risk	1×10^{-6}	ND
Ground water (µg/L)	PCP	1.0	MCL	3×10^{-6}	ND
	B2 PAHs				
	Benzo(a)pyrene	0.2	MCL	2.7×10^{-5}	ND
	Benz(a)anthracene	0.1	MCL	5.5×10^{-5}	NA[c]
	Benzo(b)fluoranthene	0.2	MCL	5.5×10^{-5}	NA
	Benzo(k)fluoranthene	0.2	MCL	5.5×10^{-5}	NA
	Chrysene	0.2	MCL	5.5×10^{-5}	NA
	Dibenz(a,h)anthracene	0.3	MCL	5.5×10^{-5}	NA
	Indeno(1,2,3-CD)pyrene	0.4	MCL	5.5×10^{-5}	NA
	D PAHs	146	hazard	NA	.9
	2,3,7,8-TCDD (Dioxin)	3×10^{-5}	MCL	1.3×10^{-4}	NA

Notes:

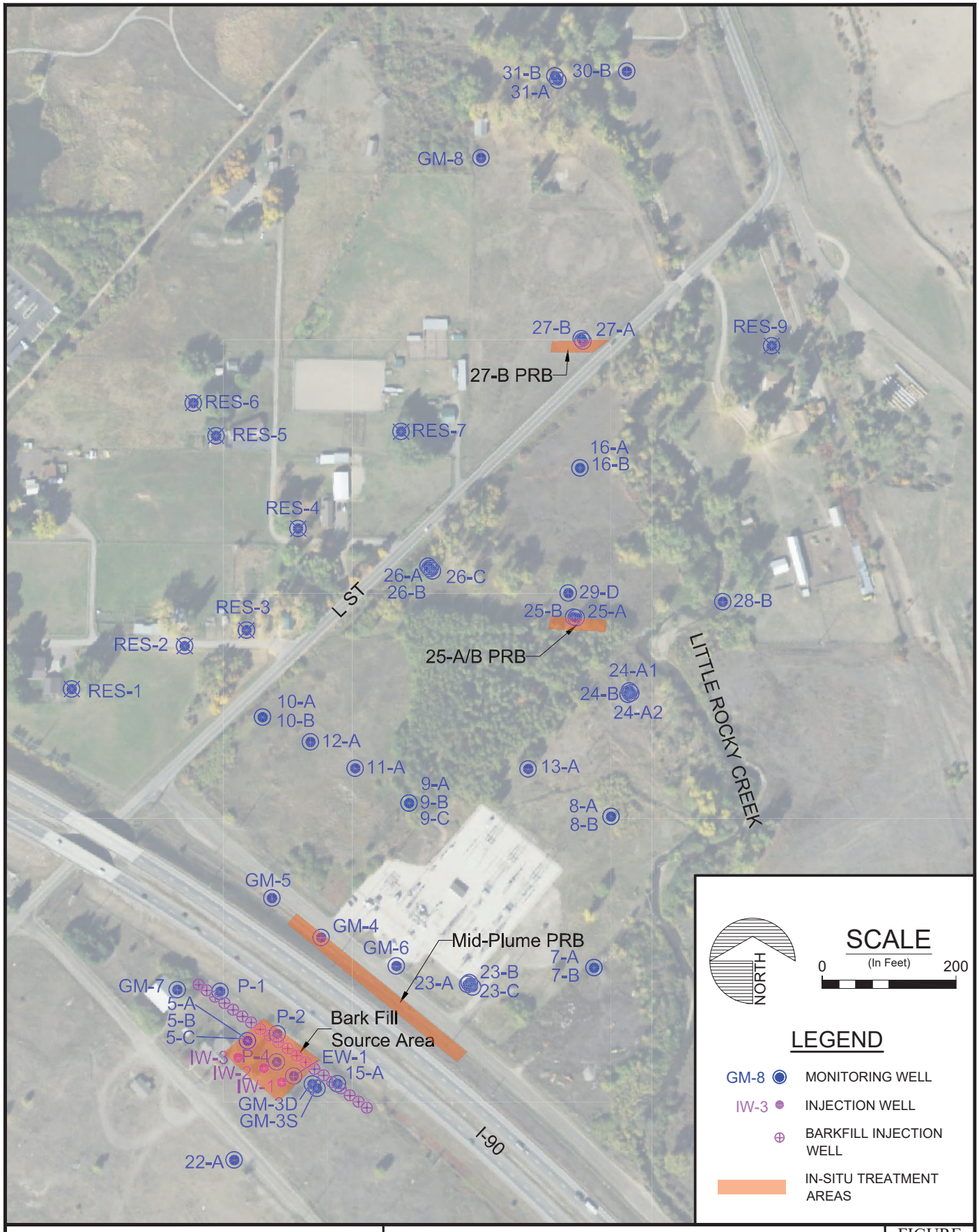
a Adjusted for cancer slope factor of 5.79 (mg/kg/day)[1].

b ND - Not determined, cleanup level for carcinogenic effects results in noncarcinogenic health hazard of < 1.0.

c NA - Not available, cleanup level established from proposed MCLs 54 Fed. Reg. 22062, 22155-57 (May 22, 1989), 55 Fed. Reg. 30370, 30445 (July 25, 1990) and promulgated MCLs 57 Fed. Reg. 31816 (July 17, 1992).

* refers to the sum of toxicity equivalents for individual polyclorinated dibenzo-p-dioxins and poly chlorinated dibenzofurans, expressed as concentration of 2,3,7,8-tetrachlorophenol dibenzo-p-dioxin (TCDD)

Note :While dioxins/furans are listed as a COC in the ROD (MDHES, 1992), they are not present at the Site above ROD cleanup levels and are not considered to be a COC for the purposes of implementing MNA at the Site.



IDAHO POLE COMPANY BOZEMAN, MONTANA 5029-300	**IN SITU TREATMENT AREAS**	FIGURE **3-1**

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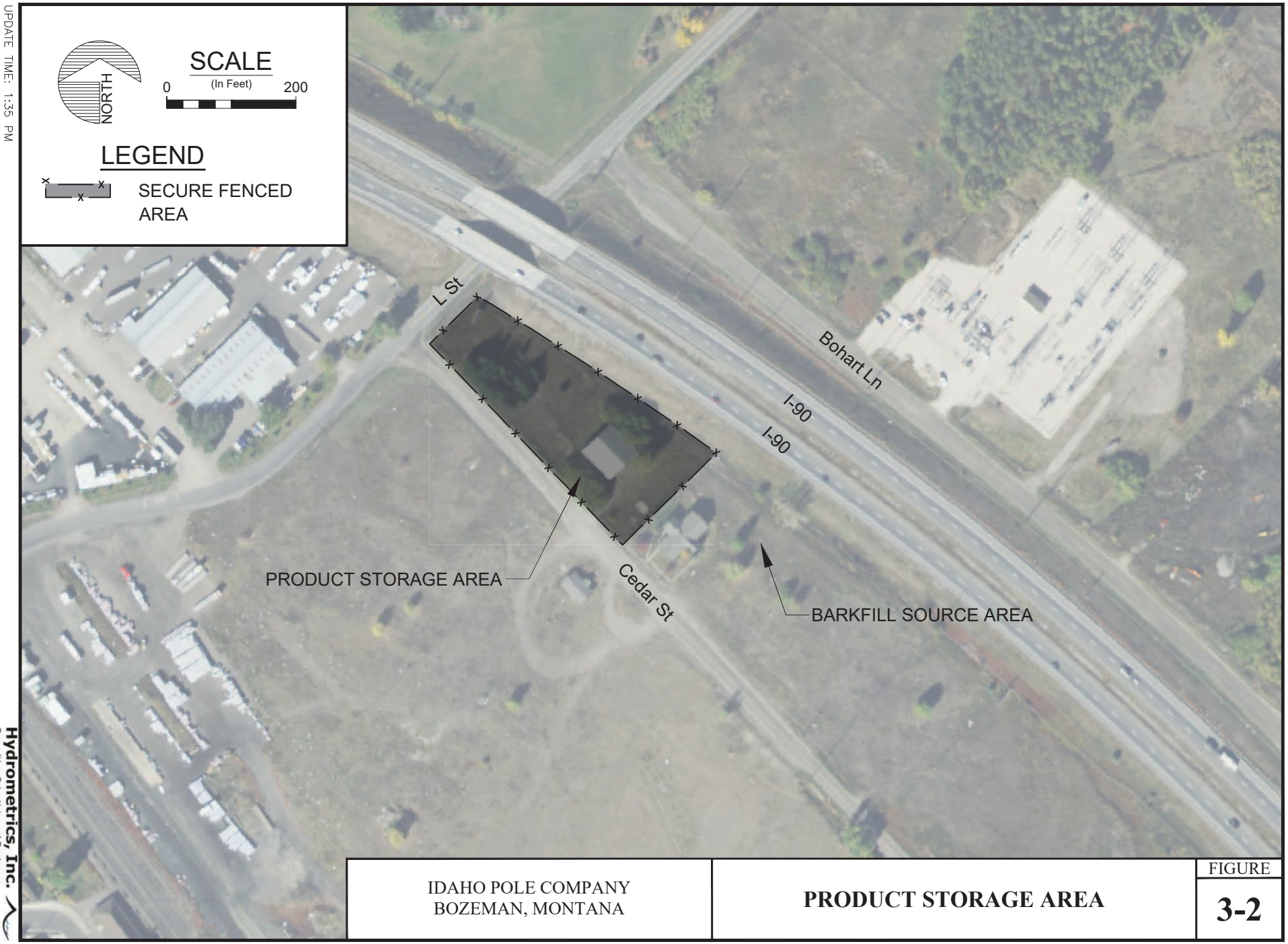
Hydrometrics, Inc.
Consulting Scientists and Engineers



IDAHO POLE COMPANY
BOZEMAN, MONTANA

PRODUCT STORAGE AREA

FIGURE
3-2

Hydrometrics, Inc.
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4 Measurement and Data Acquisition

This section covers experimental design, sampling method requirements, handling and custody requirements, analytical methods, quality control, equipment maintenance, instrument calibration, supply acceptance procedures, non-direct measurements, and data management.

4.1 Experimental Design

The principal goal of this project is to inject ISCO reagents into the subsurface to address the remaining wood treating fluids that continue to source a groundwater plume and to monitor its effectiveness over time. Water will be extracted from nearby wells during the injection process to qualitatively confirm the distribution of amendments by observing changes in color and SC. Concentrations of COCs in groundwater obtained from groundwater monitoring after the treatment program is completed will be used to determine if these injections were successful in reducing groundwater COCs in the Bark Fill Area and downgradient. Detailed experimental design for Component 1 can be found in **Section 3** of this Work Plan and **Section 6** for Component 2.

Quantifying the magnitude of improvement to water quality will serve as the basis for determining the effectiveness of the in situ amendments. Post injection performance monitoring is designed to assess whether or not the in situ amendments will meet the targeted endpoint values established in the 1992 ROD (**Table 3-5**). A reduction in wood treating fluid concentrations in groundwater will serve as the primary metric for assessing treatment system performance and are critical data. Field parameters, including pH, ORP, specific conductivity and DO, are also useful for assessing whether the conditions are conducive for COC reduction. A period of seven years has been determined by EPA to be appropriate for determining if the in situ amendments reduce COCs toward targeted endpoint values or whether additional amendments may be needed, if COC concentrations do not show declining or stable trends. If at any time during Component 2 Performance Monitoring EPA determines it is necessary to implement Components 3 and 4, EPA will notify the Respondent in writing that those Work Plans are required under the ASAOC.

4.2 Data Collection Methods Requirement

Data anticipated to be collected include daily field notes, photos, field parameters, groundwater elevations, groundwater samples and investigative derived waste samples collected to assess decontamination procedures. Logbooks and photos will be maintained as detailed in *SOP HSOP-31: Field Notebook (***Appendix C***)*. Hydrometrics' Project Coordinator will be responsible for logbook maintenance and document control. Changes to the content field logbooks shall be indicated by a single strikeout accompanied by dated initials, with the corrected information entered in close proximity to the struck-out content.

Groundwater level measurements will be conducted per HF-SOP-10; Field parameters in groundwater will be measured in accordance with HSOP-106; water samples will be collected per HF-SOP-38 and 105; and investigation derived waste will be sampled per the Waste Management Plan included as Appendix D.

4.3 Equipment Maintenance Procedures

All field equipment will be maintained based on manufacturer recommended procedures. Field instruments will be calibrated prior to, and regularly throughout the proposed timeframe. Records of all calibration activities will be maintained in equipment specific calibration logbooks. These records will be made available for data reporting purposes.

4.4 Non-Direct Measurement Data Acquisition Requirements

Non-direct measurement data to be used for the proposed work includes previously published data, pilot- and treatability test reports (Provectus May 2022) and annual monitoring reports issued by IPC's contractor as well as ISCO case studies provided by Provectus. Non-direct measurement data used to prepare this Work Plan has been reviewed and accepted by EPA and can be used in this document.

4.5 Data Management

Respondent must submit analytical results from groundwater monitoring (including field measurements, photos and laboratory results) in a Progress Report at the frequency specified in **Section 6.8.1**. Hydrometrics' Project Coordinator will be responsible for compiling and analyzing data and will be responsible for transmitting data to the EPA RPM. Logbooks, camera memory cards, and other hard copies (laboratory analytical results) of data will be kept in a locked cabinet at Hydrometrics' offices in Billings, Montana and access will be controlled by Hydrometrics' Project Coordinator. Standard hardware and software will be used to store and analyze project data and information.

4.6 Reports to Management

Weekly construction meetings will be scheduled throughout Component 1 in situ amendment injections to assess progress, identify opportunities for optimization and discuss known and anticipated obstacles. Hydrometrics' Project Coordinator or their designee will also record any quality issues encountered in the appropriate field logbook and other documentation for the project file. The QA Manager will inform the Project Coordinator, who will, in turn, inform IPC's Project Coordinator and EPA's RPM upon encountering quality issues that cannot be immediately rectified.

Upon completion of in situ amendments, a Completion Report will be prepared for MDEQ and EPA, as required by the ASAOC and this Work Plan. The report will include but not be limited to a good faith estimate of costs, a listing of the actual quantities and types of materials handled on-Site and any materials handled off-Site with the required disposal information, discussion of removal/disposal options, and a listing of the ultimate destination of those materials, a presentation of the analytical results and sampling and analyses performed, and all relevant documentation generated during in situ amendments. The Completion Report will be submitted within two months of the completion of in situ injections.

Progress reports will be submitted on a quarterly basis during the first nine months of Component 2. The reports will be submitted following each groundwater monitoring event, within 30 days of data validation of laboratory analytical results. The report will include a brief narrative of sampling methods, analytical results, field forms and laboratory reports.

5 Data Validation and Usability

5.1 Validation and Verification Methods

The Project Team and any laboratory procured to analyze aqueous source and IDW samples will perform data validation in accordance with the *National Functional Guidelines for Organic Superfund Methods Data Review, Office of Superfund Remediation and Technology Innovation* (OSRTI), (EPA, 2017). The Project Team will implement the QA/QC program included within this Work Plan to evaluate all analytical results and the Level II data validation package to determine if the results meet the project goals and objectives outlined in **Section 3.3**.

The laboratory project managers/supervisors and/or QA staff will be responsible parties for data validation and dissemination of the findings. The Project Coordinator and/or QA Manager will be in charge of post-laboratory data validation of all data generated by the laboratories.

5.2 Reconciliation with User Requirements

5.2.1 Data Evaluation

The data evaluation review for this project will address field and laboratory QC data quality indicators. The data evaluation will be documented in worksheets that will be stored along with the project files. Any major findings from the data evaluation will be discussed in the Progress Reports and/or Completion Report.

5.2.2 Data Reduction and Tabulation

Sample data, along with their laboratory and data usability qualifiers, will be reported by the laboratory and maintained electronically by the Project Team. Data reduction and tabulation will be overseen by Hydrometrics' Project Coordinator and QA Manager

6 Performance Monitoring and Evaluation

6.1 Data Quality Objectives

The systematic data quality objectives (DQO) process is used in this Work Plan to develop criteria to collect and evaluate field and analytical data for evaluation of in situ treatments at the Idaho Pole Site. The DQO process used in the development of this Work Plan includes seven steps, which are briefly outlined below (EPA 2006b).

Step 1: Problem Statement.

Contaminants of concern have been released to soil, sediment and groundwater at the Site. COC impacted soils and groundwater exceeding ROD performance standards (**Table 3-5**), is sourced at the Bark Fill Area of the IPC property and migrates downgradient in groundwater as shown on **Figure 2-1 and 2-2**.

Step 2: Identify the Goal of the Study.

The goal of the study is to inject in situ chemical reagents into the subsurface to address the remaining wood treating fluids that continue to source a groundwater plume.

Step 3: Identify Information Inputs.

The information input necessary to meet the goals listed in Step 2 will consist of groundwater environmental field data and chemical laboratory analytical data to evaluate the long-term effectiveness of in situ treatments discussed in this Work Plan.

Step 4: Define the Study Boundaries.

The study area boundaries are defined by the spatial coverage achieved from the in situ injection in the Bark Fill Area and down gradient areas as shown on **Figure 3-1**. The temporal boundary of the remedial action will continue for the duration of the injections and post treatment monitoring for seven years. If at any time during Component 2 Performance Monitoring, EPA determines it is necessary to implement Components 3 and 4, EPA will notify the Respondent in writing that those Work Plans are required under the ASAOC.

Step 5: Develop the Analytic Approach.

Decisions will be made based on COC concentrations observed in groundwater environmental field and laboratory analytical data collected.

Step 6: Specify Performance or Acceptance Criteria.

Performance and acceptance criteria for the environmental field and laboratory analytical data are identified in **Section 6.4**.

Step 7: Develop Data Acquisition Plan.

All data will be acquired in accordance with the provisions of this Work Plan. The collection of field data and groundwater samples should be adequate to evaluate reagent distribution and efficacy of the in situ treatments in reducing COC concentrations, the groundwater performance monitoring parameters and the data use.

6.2 Sampling and Analysis Plan

Groundwater monitoring will be conducted at 31 existing Site wells. These wells include "A zone" and "B zone" wells as listed on **Table 6-1** and shown in **Figure 6-1**. Residential wells will continue to be monitored annually during the fall sampling event.

Initial sampling frequency at the 31 wells will be quarterly for nine months following treatment. Sampling will continue at the frequency specified in any Revised Work Plan. Conversely, if data indicates plume expansion or other unexpected site conditions are identified during the first nine months, the sampling well network may be modified or sampling frequency would be increased. Site-wide sampling of all wells will continue to be conducted every five years, prior to each scheduled EPA 5-Year Review. The next scheduled site-wide event is planned for fall of 2024. There are no resource constraints associated with this project. Time constraints for collecting data are limited to daylight hours and consideration of weather and Site conditions.

Laboratory analysis of groundwater samples will include the following:

- PCP by EPA Method 8041A at all wells;
- PCP by EPA Method 8041A low level at residential wells during fall event only;
- PAH by EPA Method 8270 will also be conducted quarterly at well 5-A;
- Dioxins and furans by EPA Method 8290A quarterly at well 5-A; and
- Nitrate, nitrite, total organic carbon, iron and sulfate quarterly at wells listed on **Table 6-1**. These parameters will be monitored to evaluate degradation processes and distribution of amendments as described in **Table 6-2.**

A description of all analytical parameters is included on **Table 6-2**. The sampling schedule is included in **Table 6-1**.

Groundwater samples will be collected from the wells using low flow sampling techniques consistent with EPA's groundwater sampling guidelines

http://www.epa.gov/superfund/remedytech/tsp/download/lwflw2a.pdf. Representative groundwater quality will be achieved through the use of consistent purging and sample collection procedures as follows. Hydrometrics' Standard Operating Procedure for low flow groundwater sampling is included in **Appendix C**.

Once the well is unlocked and inspected, the well identification, total depth, casing diameter, and calculated tubing and well bore volumes will be recorded on field sampling forms and in a project field book.

The initial depth to water will be measured using an electric water level probe from a pre-established surveyed measuring point prior to and periodically during sampling. The water level probe will be decontaminated between wells using a 5% Alconox solution followed by a distilled water rinse. Decontamination fluids will be disposed of on the ground surface.

A peristaltic pump with Teflon or Teflon-lined tubing will be used for sampling. The bottom of the tubing will be placed mid-screen in each well.

Purge rates and pumping water levels will periodically be measured and recorded in the project field book.

Groundwater will be purged with a peristaltic pump at a rate 0.3 liters/minute or lower to minimize drawdown and mobilization of sediment from the well bottom or surrounding formation

Field indicator parameters for stabilization (DO, specific conductance, ORP, pH, and temperature) will be measured using a flow- through cell to minimize potential effects from atmospheric exposure. Field meters will be calibrated daily according to factory instructions, with results recorded on calibration forms and in the project field book. Additional calibration will be conducted if instrument drift is suspected or questionable measurements are obtained.

Samples will be pumped directly into laboratory supplied containers that are labeled with sample identification, time and date of sample collection and requested analysis. The sample containers will be placed on ice in coolers for delivery to the laboratory under chain of custody procedures.

Laboratory analysis will be performed by ARI Laboratory in Tukwilla, Washington (PCP, PAHs and total organic carbon (TOC)), Bridger Analytical Laboratory in Bozeman, Montana (iron, nitrate, sulfate) and ALS Environmental Laboratory in Houston, Texas (dioxins). **Table 6-2** details sample collection, preservation, handling, and hold times for each analytical parameter.

For QA/QC purposes, approximately one duplicate sample will be collected for every 20 groundwater samples collected, with a minimum of two duplicate to be collected per sampling event and three per five year review sampling event. Rinsate samples will also be collected at the same frequency. This sample will be collected by pumping deionized water through sample tubing and into the sample container.

Sample tubing will not need to be decontaminated since the groundwater will be collected directly in the sample containers and designated tubing will be used at each well. Purge water will be disposed of on the ground surface, as previously approved by EPA for routine semi-annual groundwater sampling, as PCP readily degrades when exposed to sunlight. Used personal protective equipment and spent supplies will be placed in plastic garbage bags and disposed at the local solid waste facility.

6.3 Data Validation

Overall completeness and adherence to project objectives is assessed through validation and verification. Verification includes confirmation of adherence to sample design, collection, handling, custody, shipping, transmittal, and documentation procedures. Validation includes the confirmation of adherence to specific analytical procedure criteria and protocols, and the assessment of data quality in terms of usability.

The laboratories (ARI, Bridger Analytical and ALS) will electronically submit to Hydrometrics a data report containing all the analytical results for each sampling effort. The report will contain a case narrative that briefly describes the number of samples, analyses, and any analytical difficulties or QA/QC issues associated with the samples. The data report will also include signed chain-of-custody forms, analytical data, a QA/QC package, and raw data. Additional reporting requirements are outlined in the laboratories contracts and quality management plans (QMP) included in **Appendix D**. Peer review of the data package, at a 100% frequency of reported versus raw data, will be performed by the analytical

laboratory. The final report of the abbreviated data validation will be in a standard electronic format, including all laboratory and instrument QC results.

Electronic data deliverables (EDDs) from the laboratory will be transferred into the project database by the Quality Assurance Manager. All data entries will be compared to hardcopy or Adobe® portable document formatted (pdf) laboratory reports, to ensure the project database remains free of transcription errors.

Hydrometrics QA Manager will evaluate completeness of data as each laboratory report is received and will conduct validation upon receipt of entire data package after each quarterly sampling event. The need for corrective action may be identified during either the data validation or data verification. Potential types of corrective action resulting from data verification may include the collection of additional samples or a summary of deficiencies. Potential types of corrective action resulting from data that are considered unusable (as determined by data validation) may include resampling by the field team or reanalysis of samples by the laboratory.

6.4 Criteria, Action Limits, and Laboratory Detection Limits

Table 6-3 provides the method detection limits (MDLs), practical quantitation limits (PQLs), while **Table 3-5** includes the cleanup levels, indicating that the analytical methods will be able to measure contaminant levels in the groundwater samples with the required sensitivity.

Precision, Accuracy, Representativeness, Completeness, Comparability, And Sensitivity.

The quarterly Progress Reports discussed in **Section 6.8.1** will discuss all precision, accuracy, representativeness, completeness, comparability, and sensitivity parameter results from the data validation and overall usability of the data for project objectives and includes the following:

PRECISION:

Field Duplicates: RPD criteria met?
Laboratory Duplicates: RPD criteria met?
Method of standard dilution performed and criteria met?
Matrix Spike Duplicates: RPD criteria met? (if applicable)

ACCURACY:

Matrix Spike/ Matrix Spike Duplicates (MS/MSDs): %R (recovery) criteria met?
Laboratory Control Sample/Laboratory Control Sample Duplicates: %R criteria met?
Initial and Continuing Calibration Recoveries met?
Interference Check Sample Recoveries met?
Inductively Coupled Plasma Serial Dilution Recoveries met?

REPRESENTATIVENESS:

Sampling Procedures and Design: Criteria met?
Holding Times and Preservation: Criteria met?
Custody: All chain-of-custody forms complete and provided in data package?
Blanks: Contaminants present?

COMPLETENESS:

The number of valid analytical results is comparable (90%) with the number determined necessary during establishment of DQOs.

COMPARABILITY:

Data compares with similar analysis and data sets?
Sample collection methods comparable to similar data sets?
Laboratory analytical methods comparable to similar data sets?

SENSITIVITY:

Method reporting limits met project objectives?

The data will be assessed for the following criteria:

- Bias – a systematic or persistent distortion of a measurement process that causes errors in one direction. The extent of bias will be determined by evaluating the laboratory initial calibration/continuing calibration verification, laboratory control spike/laboratory control spike duplicates, blank spikes, MS/MSD, and method blanks.
- Sensitivity – is the smallest value of the stimulus that can be resolved with a given degree of confidence, i.e., the detection limit. The detection limits of the field and laboratory methods are within the range of previous detections found at the site.
- Precision – the measure of agreement among repeated measurements of the same property under identical, or substantially similar, conditions and which is expressed as the RPD between the sample pairs. An acceptable RPD for water samples is 20% and 35% for sediment (EPA, 2014)
- Representativeness – the measure of the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, a process condition, or an environmental condition.
- Completeness – a measure of the amount of valid data obtained from a measurement system. The actual percentage of completeness is less important than the effect of completeness on the data set. Completeness will be assessed by the total number of samples collected vs. the amount planned.
- Comparability – the qualitative term that expresses the confidence that two data sets can contribute to common interpretation and analysis; comparability is used to describe how well samples within a data set, as well as two independent data sets, are interchangeable.

Uncertainty of validated data will be evaluated by the Hydrometrics Project Coordinator to determine if the DQOs were met. In the event that the DQOs were not met, they will be reviewed to determine if they are achievable and may be revised if necessary, and the data may be further evaluated to determine the impact to the project. Data usability and limitations will be evaluated by the Hydrometrics Project Coordinator.

6.5 Data Evaluation

After data validation, data evaluation will be performed to address monitoring objectives of this Work Plan. This evaluation will include the following.

- Verify PCP concentrations in wells in and immediately downgradient of in situ treatment areas show stable or decreasing trends over time.
- Verify PCP concentration in delineation ("plume boundary") wells show stable or decreasing trends following in situ treatments during Component 2. Detections above ROD cleanup levels (**Table 3-5**) should trigger confirmation sampling and discussion regarding potential indication of plume spreading.
- Demonstrate overall reduction in plume size, based on interpreted plume contours over time.
- Estimate dissolved PCP plume mass based on sampling results. Plume mass will be estimated by averaging the PCP concentration over the inferred area (footprint) of the plume and multiplied by the aquifer thickness and porosity. In addition, evaluation of Mann-Kendall trends for estimated dissolved plume mass over time will be considered to demonstrate overall contaminant reduction. Together, these statistical analyses can be utilized to evaluate reduction in contaminant mass over time.
- Document groundwater flow direction and gradient with measurement of water levels at Site wells during quarterly monitoring events to assist with evaluation of plume movement.
-

6.6 Reconciliation with User Requirements

If necessary, the analytical data will be qualified in order to convey the outcome of the data validation process to the end users to help them determine how the data may be applied in subsequent interpretations. The following definitions provide brief explanations of the national qualifiers assigned to results in the data review process. If additional qualifiers are needed, then a complete explanation of those other qualifiers will be included in the data review.

Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the results may be biased high.
J-	The result is an estimated quantity, but the results may be biased low.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be presented in the sample.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

6.7 Reconciliation with Data Quality Objectives

Information obtained from the field investigation will be evaluated through the data quality assessment (DQA) process by Hydrometrics Quality Assurance Manager to determine if the data are of adequate quality and quantity to support their intended use. The DQA process consists of five steps, as summarized below (USEPA, 2006a).

1) Review the project's objectives and sampling design: Review the objectives defined during the systematic planning to assure that they are still applicable. If objectives have not been deployed, specify them before evaluating the data for the project's objectives. Review the sampling design and data collection documentation for consistency with the project objectives observing any potential discrepancies.

2) Conduct a preliminary data review: Review QA reports (when possible) for the validation of data, calculate basic statistics, and generate graphs of the data. Use this information to learn about the structures of the data and identify patterns, relationships, or potential anomalies.

3) Select the statistical method: Select the appropriate procedures for summarizing and analyzing the data based on the review of the performance and acceptance criteria associated with the project objectives, the sampling design, and the preliminary data review. Identify the key underlying assumptions associated with the statistical tests.

4) Verify the assumptions of the statistical method: Evaluate whether the underlying assumptions hold, or whether departures are acceptable, given the actual data and other information about the study.

5) Draw conclusion from the data: Perform the calculations necessary to draw reasonable conclusions from the data. If the design is to be used again, evaluate the performance of the sampling design.

Uncertainty of validated data will be discussed with the EPA RPM, in consultation with the MDEQ State Project Officer, to determine if the DQOs were met. In the event that the DQOs are not met, they will be reviewed to determine if they are achievable and may be revised if necessary, and the data may be further evaluated to determine the impact to the project. Data usability and limitations will be evaluated and determined by the Hydrometrics Project Coordinator.

6.8 Documentation and Reporting

Field measurements will be recorded on field groundwater sampling forms (Appendix C) at the time of data collection by the field technician. The data sheets used to collect groundwater samples will be scanned and included in the Progress Reports discussed in **Section 6.8.1**. Field notebooks, chain-of-custody forms, groundwater sampling forms, and other forms used for the groundwater sampling will be stored at Hydrometrics office in Billings, Montana.

The documentation of the data evaluation efforts will be in the form of the work sheets prepared during validation. These worksheets will be stored electronically at Hydrometrics and included as an appendix to the annual monitoring reports.

6.8.1 Progress Report

Respondent must submit a Progress Report quarterly for the first nine months, for the initial Component 2 Performance Monitoring. Respondent must submit a Component 2 Interim Report within 30 days after the third quarter analytical data has been validated, which presents an evaluation of the first three quarters in lieu of a Progress Report. The Respondent must also submit a Revised Work Plan to address any performance modifications necessary to complete the Component 2 Performance Monitoring within 15 days after the Component 2 Interim Report has been accepted by EPA. The Respondent will be required to continue monitoring at the frequency required under this Work Plan until a Revised Work Plan has been approved by EPA. If at any time during Component 2 Performance Monitoring EPA determines it is necessary to revise this Work Plan and/or implement Components 3 and 4, EPA will notify the Respondent in writing that those Work Plans are required under the ASAOC.

Upon approval of any Revised Work Plan, Respondent must submit a Progress Report at the frequency specified in the Revised Work Plan. These reports must describe all significant developments during the preceding reporting period, including the actions performed and any problems encountered, analytical data received during the reporting period, and the developments anticipated during the next reporting period, including a schedule of actions to be performed, anticipated problems, and planned resolutions of past or anticipated problems. The Progress Report will also describe the sampling and analytical procedures presented in this Work Plan as well as any site activities that may have occurred during the reporting period. Respondent must submit the Progress Report within 30 days of validating laboratory analysis from a groundwater sampling event**.** The Progress Report will also include:

- Detailed discussion of laboratory and field parameter results and evaluations with presentation of data in tables and figures;
- Comparison of any new data with previous data and established performance criteria outlined in **Section 6-4**;
- A brief narrative that discusses observed trends or changes in groundwater characteristics will also be included in the report;
- Identify problems that may affect data usability or require that the data be qualified;
- Discussion of uncertainty with statistical measures of variability including discussion of measurement variability assessed through evaluation of QA/QC data;
- Discussion of trends and the relation of any data trends to the remedial goals;
- Recommendations for action, based on interpretation and evaluation of the new data in reference to the treatment objectives and performance criteria will be listed and discussed, if required;
- Tables will be prepared for PCP, PAHs, dioxin, anions, and field data for the wells being monitored. Figures will be prepared showing the PCP plume allowing comparison to previous conditions;
- All field documentation forms completed during groundwater sample collection and instrument calibration; and
- Laboratory issued analytical reports.

The Progress Report will also discuss all precision, accuracy, representativeness, completeness, comparability, and sensitivity parameter results from the data validation and overall usability of the data for project objectives. Distribution of the report outside of the EPA and MDEQ will be the responsibility of the EPA RPM.

6.9 Evaluation of Treatment Outcome And Monitoring Decisions

As discussed earlier, data evaluation will be ongoing and assessed after each sampling event. After the third quarterly monitoring event, PCP concentration data and field data from the post-injection groundwater monitoring will be evaluated to determine if monitoring can be reduced or expanded or if additional treatment may be necessary. Based on similar treatment at other sites, it is anticipated that the in situ treatment will cause rapid decline of PCP concentrations in groundwater within and downgradient of the treated areas. However, additional approaches to eliminating remaining source material will be evaluated if PCP levels do not respond as expected.

Table 6-1
Monitoring Schedule Post In Situ Treatment
Idaho Pole Company Site - Bozeman, MT

Note that field screening parameters will be measured at each well sampled during each event.

Well No.	Sampling Rationale	Oct 2022				Jan 2023				Spring 2022			
		PCP	PAH & Dioxin	Fe, N+N, Sulfate	TOC	PCP	PAH & Dioxin	Fe, N+N, Sulfate	TOC	PCP	PAH & Dioxin	Fe, N+N, Sulfate	TOC
5-A	Source Area	x	x	x	x	x	x	x	x	x	x	x	x
5-B	Source Area	x		x				x		x		x	
9-A	Mid-Plume	x		x	x	x		x	x	x		x	x
9-B	Mid-Plume	x		x	x	x		x	x	x		x	x
11-A	Mid-Plume	x								x			
12-A	Plume Boundary	x								x			
13-A	Plume Boundary	x								x			
15-A	Source Area	x		x				x		x		x	
16-A	Plume Boundary	x		x	x	x		x	x	x		x	x
16-B	Mid-Plume	x		x	x	x		x	x	x		x	x
23-A	Mid-Plume	x		x	x	x		x	x	x		x	x
23-B	Mid-Plume	x		x	x	x		x	x	x		x	x
24-B	Mid-Plume	x		x	x	x		x	x	x		x	x
25-A	Mid-Plume	x		x	x	x		x	x	x		x	x
25-B	Plume Boundary	x		x	x	x		x	x	x		x	x
26-A	Mid-Plume	x								x			
26-B	Plume Boundary	x				x				x			
27-A	Plume Boundary	x		x	x	x		x	x	x		x	x
27-B	Plume Boundary	x		x	x	x		x	x	x		x	x
30-B	Plume Boundary	x								x			
31-A	Plume Boundary	x								x			
31-B	Plume Boundary	x		x						x			
32-B (new)	Mid-Plume	x		x	x	x			x	x			x
EW-1	Source Area	x		x				x		x		x	
GM-4	Mid-Plume	x		x	x	x		x	x	x		x	x
GM-5	Plume Boundary	x				x				x			
GM-6	Mid-Plume	x		x	x	x		x	x	x		x	x
IW-1	Source Area	x		x		x		x		x		x	
P-1	Source Area	x								x			
P-2	Source Area	x		x		x		x		x		x	
P-4	Source Area	x		x	x	x		x	x	x		x	x
RES-1 to 9	Residential	x								x			

PCP - Pentachlorophenol (EPA Method 8041A)
PAH - Polycyclic aromatic hydrocarbons (EPA Method 8270-SIM)
Dioxin - Dioxins and Furans (EPA Method 8290A)
Field Screening - DO, ORP, pH, Temperature, Conductivity

TABLE 6-2
IN SITU TREATMENT PERFORMANCE GROUNDWATER MONITORING PARAMETERS
IDAHO POLE COMPANY - BOZEMAN MONTANA

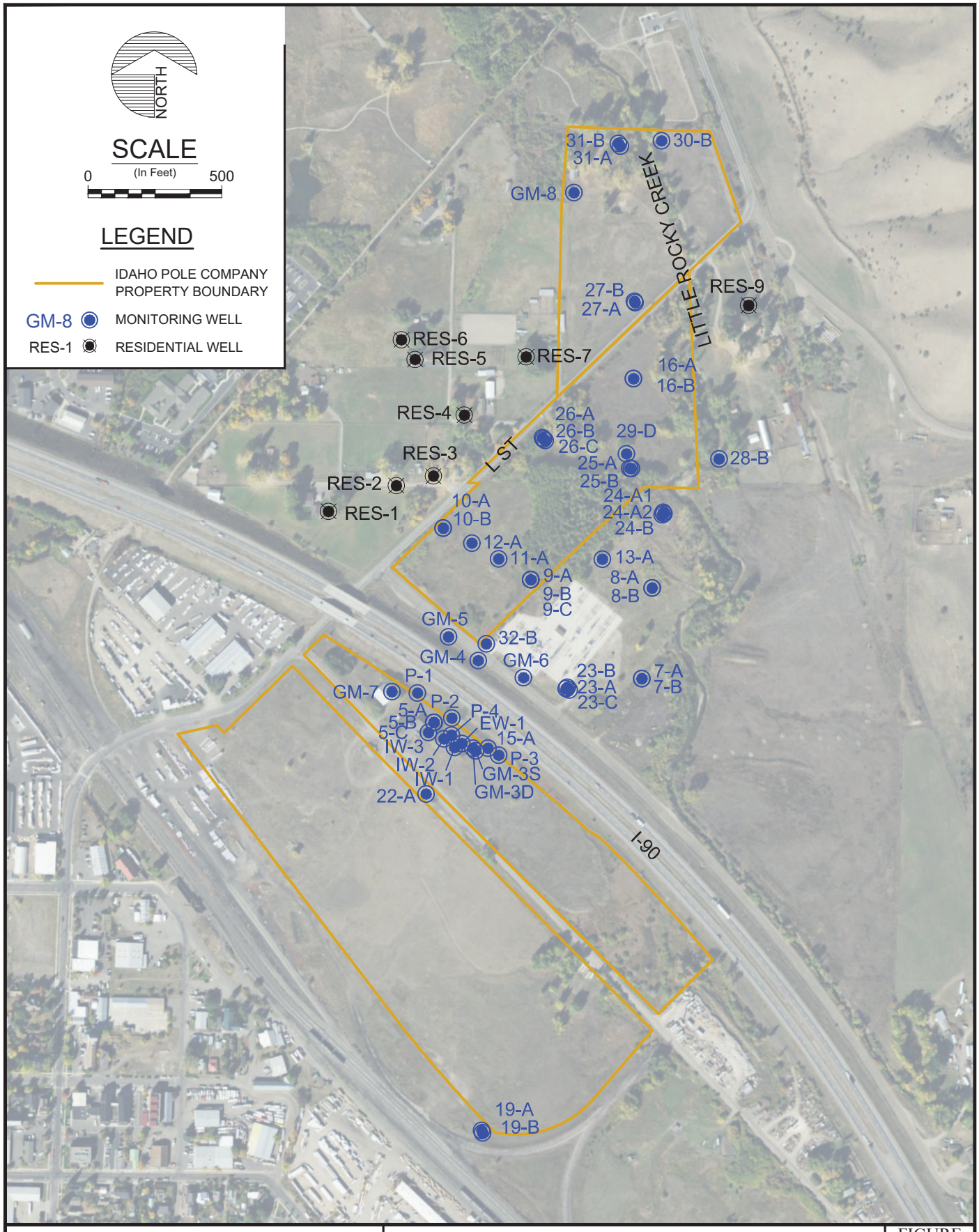
Parameter	Method	Data Use / Interpretation	Container	Preservation	Hold Times	Practical Quantitation Limit
Chemicals of Concern						
Pentachlorophenol (µg/L)	USEPA Method 8041A	Pentachlorophenol (PCP) has historically been used at the site as an indicator for plume location and remedy effectiveness. PCP concentrations will be used to evaluate monitored natural attenuation (MNA) rates.	1 liter glass amber	Cool, 4^{O}C	7 days	0.25 ug/L
Polynuclear aromatic Hydrocarbons (µg/L)	USEPA Method 8270	PAH concentrations will be used to evaluate MNA rates.	1 liter glass, teflon lined cap	Cool, 4^{O}C	7 days to Extraction; 40 days after	0.10-0.20 ug/L
Dioxins furans (pg/L)	USEPA Method 8290A	Dioxin concentrations will be used to evaluate potential plume migration.	1 liter glass amber	Cool, 4^{O}C	30 days	0.5 pg/L*
Geochemical Parameters						
Iron	HACH 8008	Ferric iron oxide is included in Provect-OX2®, during treatment it is reduced to ferrous iron, this indicator of anearobic activity	50 milliliter/plastic or glass	Store at ≤6°C	48 hours	0.1 mg/L
Nitrate and Nitrite	EPA 300/SW9056	Electron acceptor for microbial respiration in the absense of oxygen.	50 milliliter/plastic or glass	Store at ≤6°C	48 hours	0.1 mg/L
Sulfate	EPA 300/SW9056	Electron acceptor for anaerobic microbial respiration.A decreasing trend and concentrations less than 20 mg/L are indicative of degradation.	100 milliliter/plastic or glass	Store at ≤6°C	28 days	1 mg/L
Total Organic Carbon	EPA 415.2	Indicator of general food sources, including Provect-OX2	125 milliliter/glass	Store at ≤6°C, Preserve with sulfuric acid	28 days	1.5 mg/L
Field Water Quality Parameters						
Temperature (degrees Celcius)	Direct Reading Meter (field)	General measure of groundwater conditions. Increases in temperature above baseline could suggest increased	NA	NA	NA	.01 ^{o}C
Specific Conductivity (umhos/cm)	Direct Reading Meter (field)	General measure of groundwater conditions.	NA	NA	NA	1 µmhos/cm
Static Water Level (ft below ground surface)	Direct Reading Meter (field)	General measure of groundwater conditions and for use in understanding groundwater flow directions.	NA	NA	NA	.01 feet
Oxidation Reduction Potential (mV)	Direct Reading Meter (field)	The oxidation reduction potential (ORP) is a measure of whether oxidative or reducing conditions are present, and is a line of evidence for aerobic and anaerobic biodegradation, respectively.	NA	NA	NA	NA
Dissolved Oxygen (mg/L)	Direct Reading Meter (field)	Dissolved oxygen (DO) is a measure of whether the groundwater presents an aerobic or anaerobic environment. DO greater than 0.5 mg/L generally indicates an aerobic environment. DO greater than 2 mg/L is typically necessary for aerobic degradation. Low DO indicates an anaerobic environment. DO less than 0.5 mg/L is typically necessary for anaerobic degradation.	NA	NA	NA	0.1 mg/L
pH	Direct Reading Meter (field)	The ideal range of pH for dechlorinating/degrading bacteria is 5 to 8. Decreases below the historical range or baseline (i.e., more acidic conditions) may indicate enhanced microbial activity and CO2 production. A pH range of 5 to 8 should be maintained to maintain effective biological activity.	NA	NA	NA	0.1 s.u.

* Method Detection Limits will vary according to homologue group and matrix interferences

TABLE 6-3
METHOD DETECTION LIMITS AND
PRACTICAL QUANTITATION LIMITS FOR COCs
IDAHO POLE COMPANY - BOZEMAN MONTANA

Parameter	Method	Method Detection Limit	Practical Quantitation Limit
Chemicals of Concern			
Pentachlorophenol	USEPA Method 8041A	0.09 ug/L	0.25 ug/L
Polynuclear Aromatic Hydrocarbons	USEPA Method 8270D-SIM		
Acenaphthene		0.03 ug/L	0.10 ug/L
Acenaphtheylene		0.04 ug/L	0.10 ug/L
Anthracene		0.04 ug/L	0.10 ug/L
Benzo(a)anthracene		0.04 ug/L	0.10 ug/L
Benzo(a)pyrene		0.04 ug/L	0.10 ug/L
Benzo(b)fluoranthene		0.04 ug/L	0.10 ug/L
Benzo(g,h,i)perylene		0.04 ug/L	0.10 ug/L
Benzo(k)fluoranthene		0.04 ug/L	0.10 ug/L
Chrysene		0.03 ug/L	0.10 ug/L
Dibenz(a,h)anthracene		0.05 ug/L	0.10 ug/L
Fluoranthene		0.03 ug/L	0.10 ug/L
Indeno(1,2,3-CD)pyrene		0.04 ug/L	0.10 ug/L
Naphthalene		0.03 ug/L	0.10 ug/L
Phenanthrene		0.03 ug/L	0.10 ug/L
Pyrene		0.04 ug/L	0.10 ug/L
Total Benzo-Fluoranthenes		0.09 ug/L	0.20 ug/L
2,3,7,8-TCDD Based Dioxin, TEQ	USEPA Method 8290A	0.01 pg/L	0.5 pg/ L

*For other congeners multiply the values by 1 for TCDF/PeCDD/PeCDF, by 2.5 for HxCDD/HxCDF/HpCDD/HpCDF, and by 5 for OCDD/OCDF.



IDAHO POLE COMPANY BOZEMAN, MONTANA 5029-300	**MONITORING WELLS AND MAP OF THE IDAHO POLE SITE**	FIGURE **6-1**

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Hydrometrics, Inc.
Consulting Scientists and Engineers

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Appendices

Appendix A – Provectus Statement of Qualifications and Relevant Case Studies

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International Offices
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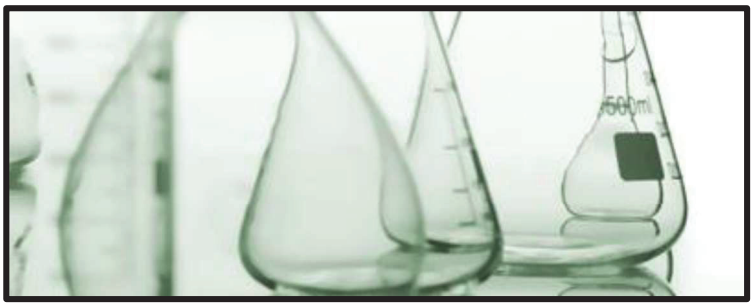
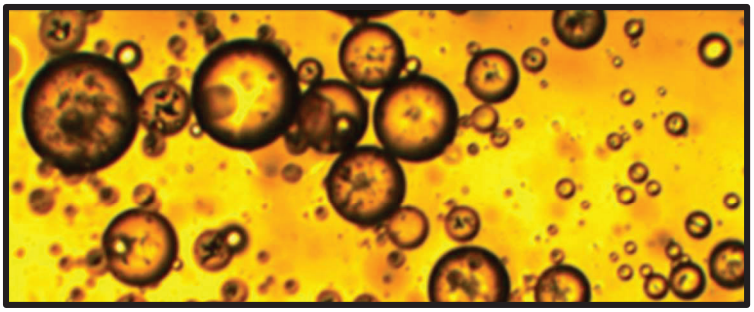
Manta, Italy
New Taipei City, Taiwan





Statement of Qualifications

Provectus
ENVIRONMENTAL PRODUCTS™

STATEMENT OF QUALIFICATIONS

Provectus (Latin) = advanced; higher level of knowledge. Provectus Environmental Products, Inc. (Provectus) is a performance technology and service provider to the remediation industry. We specialize in the development and global commercialization of next-generation, synergistic *in situ* chemical (reduction and oxidation), and biological remedial technologies. Our proprietary technology portfolio represents the safest, most effective, and most cost-efficient solutions available to our industry.

We are not consultants. Our business model is to support responsible parties, environmental engineers, technical consultants, governmental regulators, and the wider academic community by providing technical evaluation, design, field services, and support of cost-effective and innovative remediation strategies.

Distinctive Environmental Biotechnologies

The Provectus line of patented environmental remediation products are truly different, and they represent genuinely unique chemistries: they are not simply "me too" modifications of existing environmental technologies. As you review our technology portfolio, common features will be apparent: a clear focus on safety, tangible cost efficiencies, demonstrated effectiveness, distinguishable ease of use, and recognizable quality at the highest level. The technologies are summarized below with several Technical Data sheets attached as **Appendix A**.

- **Provect-IR® Solid ISCR Reagent:** As the prime originator and developer of the original EHC ISCR reagent over 15 years ago, we know that Provect-IR® is a genuine improvement on the ISCR process and older product formulations. Provect-IR® is a more efficient, cost effective, and safer ISCR approach that can be combined with our antimethanogenic reagents (AMRs) to control methanogenesis.
- **Provect-IRM® Solid ISCR Reagent / Metal Stabilization Reagent:** The Provect-IRM® technology core is an effective means of metal immobilization/ISCR that minimizes production of methylmetal(loids) for safer and long-term immobilization.
- **Provect-ERD® + DVI Liquid Reagent:** The most cost-effective formulation of a liquid ERD amendment that can be applied via direct push or screened systems. By inhibiting methanogenesis using multiple AMRs, this is a more efficient, longer-lived, and safer ERD approach. Dual valent iron (DVI) can be added to the blend to create ISCR conditions.
- **Provect-OX® Self-Activating ISCO + Bioremediation Reagent**: Sodium persulfate-based *in situ* chemical oxidation (ISCO) reagent that is unique in terms of its safety (no extreme activators; no heat generated) and effectiveness, as it actively integrates enhanced bioremediation as part of the overall treatment process. The technology is designed to manage contaminant rebound.
- **Provect-OX2™ Extended Release ISCO + Bioremediation Reagent**: Same chemistry and advantages associated with Provect-OX® with potassium persulfate added to the

reagent blend to extend the ISCO lifespan. Ideally suited to address significantly impacted sites, addition to excavations, and creation of permeable reactive barriers.

- **EZVI Technology:** Unique reagent that can be used for safe and effective treatment of chlorinated solvent dense non-aqueous phase liquid (DNAPL) and sorbed mass sources.
- **Provect-EBR:** Patented technology that continuously electrochemically converts groundwater into hydrogen peroxide in the presence of ferrous iron thereby generating hyper-reactive oxygen species. These extremely reactive components can oxidize a vast array of contaminant species. The system is remotely monitored and controlled to reduce operational costs.
- **Commodity Reagents:**
  - Zero-Valent Iron (ZVI): Provectus offers ZVI to the global remediation industry. A wide range of ZVI particle sizes are available including coarse, fine, and micro for traditional applications and permeable reactive barriers.
  - Oxygen Release Substrate (ORS and ORS-Sleeve™): Slow-release solutions to complement removal of source area (e.g., placement within excavated area) or for well deployment (e.g., existing morning/injection wells). The proprietary reagents provide a source of dissolved oxygen and inorganic nutrients to enhance aerobic biodegradation of groundwater hydrocarbons.

Corporate Resources

Provectus is a company designed to work. Our people harbor and display the personal characteristics, technical skills, and inherent professionalism upon which we are growing our company – all with a crisp focus on client appreciation.

- **Credible Technical Aptitude**: Highly qualified staff, including Ph.D. level scientists and others representing more than 150 cumulative years' experience with environmental biotechnology; inventors and developers of multiple physical, chemical and/or biological remediation technologies.
- **Design and Implementation Experience**: Our team has remediated over 1,500 sites worldwide utilizing a wide range of technologies and application methods. Our design and field experience provides a significant advantage over other vendors that focus on product sales not real-world applications.
- **Technologies Yield Predictable, Reliable Performance:** Patented and patent-pending technologies that have predictable performance in conjunction with strategic providers and applicators.
- **Responsive Customer Care and Service:** Logistics with no surprises, no excuses, no frustration. User-friendly and cordial account management personnel.

- **Quantifiable Client Value:** Safer, more effective, more cost-efficient remedial actions. "Do it Right the First Time" - avoid problems associated with new and emerging regulations for methane in groundwater, soil gas, and indoor air.

Flexible Contracting Options and Preferred Network

Provectus offers variable and flexible contracting options that can be developed on a project-specific basis. Our contracting options range from straightforward, product-specific agreements to team bids that include turn-key remediation solutions for complex sites. Provectus is a technology provider that has established partnerships with a preferred network of global vendors and applicators. **Appendix B** includes several case studies outlining typical Provectus projects.

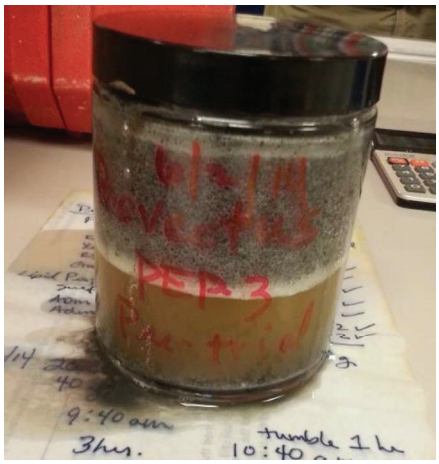
Patented Biotechnologies

The Provectus line of patented (eight issued patents) and patent-pending (one pending) environmental remediation products are truly different, and they represent best in class, globally.

Application / Patent Number	Title	Filing Date	Issued Date
7,129,388 and 7,531,709	Method for Accelerated Dechlorination of Matter; Parts 1 and 2		10/31/2006 and 05/12/2009
7,828,974	Method for the Treatment of Ground Water and Soils Usind Dried Algae and Other Dried Mixture		11/09/10
8,147,694	Method for the Treatment of Ground Water and Soils Uxing Mixtures of Seaweed and Kelp		04/03/12
8,766,030	Utilization of Ferric Ammonium Citrate for In-Situ Remedation of Chlorinated Solvents		07/01/14
9,221,699	Method for Inhibition of Methane Production During Anaerobic Reductive Dechlorination		12/29/15
9,126,244	Use of Encapsulated Substrates to Control the Release Rates of Organic Hydrogen Donors		09/08/15
9,126,245 B2 and 9,427,786	Chemical Oxidation and Biological Attenuation Process for the Treatment of Contaminated Media		09/08/15
9,637,731	Method and Composition for Inhibiting Heavy Metal Methylation During In Situ Remedial Actions		05/02/17
15/269,903	Inhibition of Methanogenesis to Control Wood-Boring Insects and Pestilence	09/19/17	

APPENDIX A

Provect-IR™
Antimethanogenic ISCR Reagent



TECHNOLOGY DESCRIPTION

Provect-IR is a unique mixture of reagents combined into a single product that optimizes the *in situ* reductive dechlorination of chemicals present in soil, sediment, and groundwater. It acts by promoting synergistic interactions between:

- Natural antimethanogenic compounds
- Hydrophilic, nutrient rich organic carbon sources
- Zero-Valent Iron (ZVI)
- Chemical oxygen scavengers
- Vitamin and mineral sources

This distinctive, patented combination of natural and food-grade chemicals promotes ISCR conditions for fast and effective destruction of targeted constituents of interest (COIs) such as chlorinated solvents, organochlorine pesticides, and other halogenated compounds (Brown *et al.,* 2009; Dolfing *et al.,* 2008; US Patent Office Scalzi *et al* 2012). Notably, Provect-IR is the only ISCR reagent to simultaneously inhibit the production of methane during the requisite carbon fermentation processes (US Patent Office Scalzi *et al*, 2013, 2014). This promotes more efficient use of the hydrogen donor while avoiding negative issues associated with elevated methane (CH4) in groundwater, soil gas, and indoor air.

Current regulations for methane in groundwater vary from *ca*. 10 to 28 mg CH4/L (Indiana Department of Environmental Management, 2014). More State regulations are pending, with several ERD projects which intended to use liquid carbon (emulsified oils) sources failing to receive regulatory approval due to issues associated with excessive production of methane during previous technology applications (Personal Communication - State of California; State of Minnesota). Many remedial practitioners have subsequently been required to establish contingencies for conventional ERD/ISCR implementation in the event that methane exceeds a threshold level ranging from 1 ppm to 10 ppm groundwater. These contingencies often entail expensive and extensive systems for capturing and treating methane in soil gas/vapor captured via SVE systems.

MODE OF ACTION – HOW DOES IT WORK?

What is a Methanogen? In the 1970s, Dr. Carl Woese (1928 to 2012) and his colleagues at the University of Illinois-Urbana studied prokaryotic relationships using DNA sequences and they found that microbes that produce methane – or methanogens - are Archaea (Woese and Fox, 1977). The identification of this new Domain of microorganism was very important for many reasons, but from our limited perspective herein this vast difference in genetic composition means that methanogens are significantly different from typical heterotrophic bacteria and eukaryotes. In other words, *Dehalococcoides ethenogenes* are as different from methanogens as you are.

What is a Statin? A Statin can be defined as "a class of lipid-lowering drugs that reduce serum cholesterol levels by inhibiting a key enzyme involved in the biosynthesis of cholesterol". Lovastatin is a widely known, potent statin used for decades to lower cholesterol in human blood by inhibiting 3-hydro-3-methylglutaryl-coenzyme A (HMG-CoA) reductase, which is a key enzyme in the cholesterol biosynthesis pathway (Alberts *et al.,* 1980). It was the first statin approved by the United States Food and Drug Administration in 1987 as a hypercholesterolemic drug.

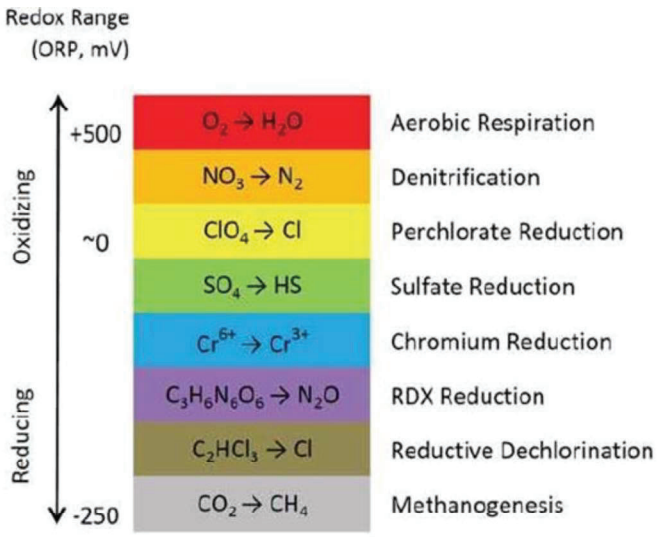
What is Red Yeast (Rice) Extract? The red yeast rice (RYR) extract that is component of Provect-IR is a substance extracted from rice that has been fermented with a type of yeast called *Monascus purpureus*. Red yeast extract is used as a food coloring, food additive/preservative, and is widely consumed by humans. The RYR extract contains a number of monacolins - most importantly, Monacolin K, otherwise known as Lovastatin or Mevinolin. Monacolin K is the only naturally occurring statin compound. In addition to Monacolin K, RYR extract also contains mono-unsaturated fatty acids and other vitamins that will effectively stimulate anaerobic bacteria in the subsurface.

So - How Does a Statin Inhibit a Methanogen? Interestingly, Monacolin K is a potent inhibitor of methanogenic archara because cell membrane production in archaea shares a similar pathway with cholesterol biosynthesis (Miller and Wolin, 2001). And since methanogens are so uniquely different than bacteria, the inhibitory effect is not observed in microbes that are typically associated with: i) catabolism of organic contaminants (such as pseudomonas species) and/or, ii) halo-respiration/biodegradation of chlorinated solvents (such as dehalococcoides species). RYR has been used in the cattle industry for decades in efforts to manage rumen microbiology and control methane production in cows.

ATTENUATION PROCESSES – SAFER, MORE EFFICIENT ISCR TREATMENT

In situ chemical reduction (ISCR) as defined by Dolfing *et al* (2008) describes the combined effect of stimulated biological oxygen consumption (via fermentation of an organic carbon source), direct chemical reduction with zero-valent iron (ZVI) or other reduced metals. The corresponding enhanced thermodynamic decomposition reactions that are realized at the lowered redox (Eh) conditions allow for more effective mineralization of many COIs.

A number of enhanced reductive dehalogenation (ERD) substrates and other accelerated anaerobic bioremediation technologies exist (*e.g.*, emulsified oils, non-emulsified oils, carbon-based hydrogen release compounds, vegetable matter + ZVI amendments) that purportedly offer similar responses. However, the Provect-IR antimethanogenic ISCR substrate is unique in its ability to yield Eh values most conducive to reductive dechlorination while simultaneously preventing methane production - which is a waste of the H being generated and potentially a safety issue under field conditions.



Provect-IR uniquely combines RYR extract with of a variety of specially selected reagents in order to induce genuine ISCR conditions and faciliate the destruction of targeted COIs in a safer, more efficacious manner. As outlined below, it can be used to manage environments impacted by chlorinated solvents, pesticides, heavy metals and other COIs.

Specially Selected Organic Hydrogen Donors: A variety of hydrophilic, nutrient rich organic carbon sources are incorporated in Provect-IR that assist in promoting the ISCR process. The Provect-IR bioremediation amendments consist of slow, medium and long-term release carbon sources. Such a formulation is desirable because it provides both a rapidly utilized electron donor (calcium propionate), slow-release long-term electron donors (kelp meal and yeast extract) and long-term release carbon sources (other cellulose and hemi-cellulose carbon such as soy meal). More specifically,

- Calcium propionate and other readily biodegradable carbon sources: Following the addition of simple carbon sources such as lactate, formate, ethanol or glucose to an aquifer setting these compounds are often converted rapidly to hydrogen and acetate. Although this is the desired response, the process is sometimes too rapid, and this can result in aquifer acidification (due to rapid VFA production) and the liberation of too much hydrogen (which allows methanogens and sulfate reducers to compete effectively with dehalogenators, which tend to grow more slowly). Hence, calcium propionate is used as a readily biodegradable carbon source.
- Yeast extract: This supplement provides a variety of organic hydrogen donors that have slower release profiles (*i.e.*, they are not fermented as rapidly as proprionate). Yeast extract also contains biological components that are very useful to anaerobes, but are not available through other carbon-only media. In particular, yeast extract provides an abundant source of priming ATPase along with trace nutrients and vitamin B complexes.
- Kelp meal/Cellulose based carbon: These hydrogen sources are composed of a hydrophilic, solid and complex carbon that ferment more slowly and inherently generate less methane. The hydrophilic organic component of the kelp meal, for example, is composed of cellulose and hemicellulose and it may be treated during the manufacturing process so that some of the components more easily undergo hydrolysis to glucose while maintaining an overall longevity of 3 to 5+ years.

Chemical Oxygen Scavengers: The presence of chemical oxygen scavengers such as sodium sulfite helps minimize performance lag phases that are often observed following the injection of remedial amendments. This is due, in part, to the presence of oxygen that is introduced as a result of the field mixing and blending operations. It takes a cerain amount of time and reagent consumption to remove that introduced oxygen and allow the ISCR reactions to proceed. Provect-IR is unique it that manages this impact chemically, which is a more effective, reliable manner thus allowing the ISCR process to be more effective.

Zero-Valent Iron: The presence of ZVI in Provect-IR is critical to ISCR reactions. The ZVI is added as a reduced material that is oxidized during the reductive dechlorination reactions which use ZVI as the reducing agent. The *beta*-elimination reaction mainly produces (chloro)acetylene, ethane/ethane and chloride ions, without the accumulation of potentially problematic catabolites typical of microbiologically mediated sequential reductive dehalogenation processes (*e.g.,* DCE "stall"). As the ZVI reacts, hydroxyl ions are released and pH increases which is useful in neutralizing the acidity generated during the fermentation of carbon, where acids are generated. Oxidized iron species are also prodcued, where are useful in *alpha*-elimination reactions and iron cycling. One limitation to ZVI reactions is that they are surface mediated which means that direct contact is required for direct COI destruction.

RYR Extract: Provect-IR is the only ISCR amendment that will rapidly induce ISCR conditions while simultaneously preventing or significantly minimizing the production of methane. The benefits are notable:

- Safer: Methane is explosive with an LEL of 5% and an UEL of 15%. Production of methane will result from the addition of any conventional ERD or ISCR amendment: excessive and extended production of methane can result in elevated in groundwater concentrations (as high as 1,000 ppm have been reported) which can lead to accumulation in soil gas subsequently impacting indoor air. State specific regulations for methane in groundwater have been promulgated, with others pending for soil gas and indoor air.

- More Efficient = More Cost Effective: Production of methane is a direct indication that the hydrogen generated from the organic carbon amendments was used by methanogens and the amendment has been wasted because it was not utilized by acetogens or dehalorespiration. By inhibiting the growth and proliferation of methane producing Archaea, chlororespiring bacteria can become the more dominant bacterial populations.

PRIMARY FEATURES:

- Effective: No accumulation of dead-end catabolic intermediates as a function of substrate addition (as is common with [emulsified] oils and sources of carbon only).
  - Does not rely on physical sorption/sequestration as a major "removal" mechanism (as is common with oils).
  - Inherently buffered for pH control – will not acidify an aquifer and liberate heavy metals as potential secondary COIs.
- Efficient: Significantly lower costs as a result more efficient amendment utilization and avoidance of contingencies for methane management. No need for additional buffers.
- Safe: Fewer health and safety concerns as compared with use of traditional ERD or ISCR reagents; Avoid issues associated with new and emerging methane regulations.
- Ease of Use: Green and sustainable. All components integrated in a single package. Logistics with no surprises.
- Longevity: Engineered profile of carbon sources for multi-year longevity estimated at 3 to 7 years based on site-specific hydrogeology. Reagent will stay in place and remain active which prevents rebound.
- Improved Performance: More efficient use of hydrogen donors (does not get wasted as methane).
- Adaptable Formulations for Heavy Metals: Will not mobilize arsenic or other heavy metals yielding secondary contaminants (as is common with [emulsified] oils and sources of carbon only). Can be formulated to manage environments that are co-impacted by various inorganic contaminants (*e.g.*, As, [Hg], Ni, Pb, Zn) while simultaneously mineralizing the organic compounds.
- Patented Technologies: Technology end users and their clients are fully protected from all Patent and other legal issues.

PHYSICAL PROPERTIES:

Particle Size: ranges from ca. <5 to 100 micron (can be manufactured to specifications).

Dry Density: ranges from 0.4 to 0.5 g/cm3

29% Aqueous Slurry Density: ranges from 0.9 to 1.0 g/cm3

29% Aqueous Slurry Viscosity: ranges from 500 to 1,500 cP

SLURRY PREPARATION GUIDELINES:

Percent Solids Content	Mass of Provect-IR	Volume of Water (US gallons)
10%	25 lb	27
20%	25 lb	12
30%	25 lb	7

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CONTACT US FOR A COMPLIMENTARY SITE EVALUATION

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Multiple remedial contracting options available via strategic providers

Turn-Key, Risk-Reward, Pay-for-Performance, Remedial Guarantees/Warranties

Technical Data Sheet
Provect ERD CH4+DVI

Provect-ERD CH4+™ contains proprietary fermentable carbon sources plus water-soluble, dual-valent iron (DVI) and - where appropriate - Antimethanogenic Reagent (AMR) technology to yield the industries' only liquid ISCR amendment to enhance the removal of chlorinated volatile organic compounds (CVOCs) from soil and groundwater. As outlined herein, this technical approach makes use of screened wells and offers the benefits of:

- Can be applied via screened wells
- Ease of use (can self-perform)
- Increased reliability and improved performance beyond ERD alone
- *In situ* formation of mackinawite and other iron sulfides
- Extended longevity (remedial action persists for many years)
- Reduced risk of regulatory exceedances for methane, and
- Avoidance of possible health and safety issues (vapor intrusion, induced plume migration)
- Custom formulations available

PROVECTUS ERD-CH4+ TECHNOLOGY BACKGROUND

Provectus' ERD-CH4**+** technology represents a significant advancement in environmental biotechnology by combining the proven biochemistry of ERD with the power of the Provect-CH4® methanogen inhibitors to yield a truly unique liquid, antimethanogenic ERD reagent.

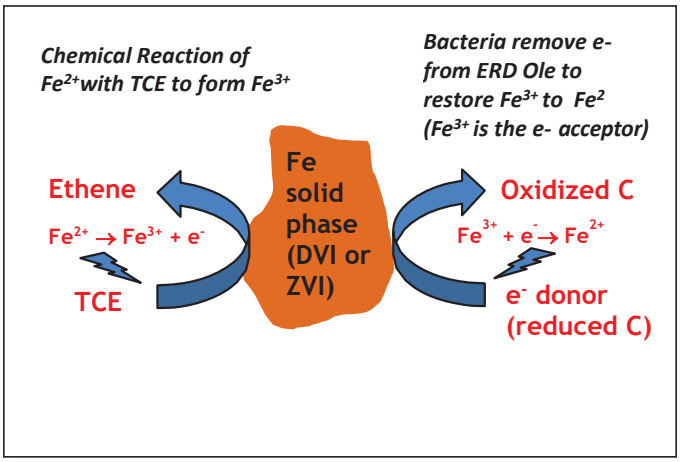
Fermentable Carbon Source: The amendment is manufactured and shipped as a prepared mixture that contains 60 - 85% fermentable carbon (FC) and:

- Optional Provect-CH4® AMR (two types typically at 4% to 8% weight of FC)
- Glycerin as fast-release H donors
- Soluble lactic acid as mid-release H donors
- Ethyl lactate as a green solvent and H donor
- Dissolved Fatty acids as long-term release H donors
- Dipotassium phosphate for micronutrients and pH buffering
- Potash or bicarbonate for pH control
- Custom formulations available

Antimethanogenic Reagents (AMR) to control of Excessive Methanogenesis: Provect-CH4® is a food-grade, natural source of Monacolin K (otherwise known as Lovastatin) and other statin compounds and/or essential plant oils with a demonstrated ability to prevent excessive methane

(CH_4) production by inhibiting the growth and proliferation of methanogenic Archaea. In environmental remediation applications, it can be used as a supplement to conventional ERD and *in situ* chemical reduction (ISCR) amendments to control excessive methanogenesis thereby rendering them safer, more effective and more cost efficient.

Dual valent Iron (DVI): Provect-ERD-CH4**+** is supplemented with a source of a soluble, reduced iron (*i.e.,* present as ferrous [Fe^{2+}] iron). The DVI supports direct chemical dechlorination via *alpha*-elimination pathways, and it supported the formation *in situ* of reactive ferrous minerals (*e.g.,* magnetite) and – in the presence of a sulfur source – reactive iron sulfides (*e.g.,* mackinawite) to yield abiotic reductive dechlorination. These abiotic pathways often result in complete dechlorination (Weber *et al*., 2006) and can persist for many years (if an electron donor is available) being catalyzed by indigenous iron-reducing bacteria. Notably, biotransformation of Fe^{2+} does not require direct contact with the iron solid phase as a variety of naturally-occurring biological molecules, such as humic acids, can facilitate electron shuttle dynamics.



ADVANTAGES OF USING PROVECT- CH4 METHANE CONTROL TECHNOLOGY

There are recognized benefits to methanogens and of limited methanogenesis. For example, i) methanogens are known to play important roles in synergistic microbial ecology, ii) their metabolic activity can help create and maintain anoxic conditions in treatment zones (through seasonal changes), and iii) the activity of methane mono-oxygenases and other enzymes can stimulate co-metabolic activity of TCE/DCE/VC in redox-recovery zones. Hence, limited production of methane is part of a healthy ERD/ISCR application.

However, excessive methane production represents a costly waste of the amendment since the hydrogen released as methane was not utilized by the targeted microbes, such as *Dehalococcoides* spp., *Dehalobacter* spp., or other related bacteria. In addition, excessive methanogenesis can pose significant safety issues (methane is explosive), it will induce vapor migration and it can lead to exceedances of new and emerging regulatory guidelines. Moreover, uncontrolled methanogenesis can be interpreted (by some) to represent an avoidable contribution

to greenhouse gas emissions, hence its active control can have a positive impact on one's overall sustainability index.

PROVECT- ERD CH4+ PRIMARY FEATURES

Because Provect-ERD-CH4**+** provides both fermentable carbon and supplemental DVI, the Fe^{+2} ions donate electrons and are oxidized to Fe^{+3} for an extended period (years). Where needed (*i.e.*, in the presence of low sulfate), additional source of sulfur is included in the product formulation. General physical parameters are as follows:

- Viscosity = 10 to 15 cP at 20 C
- Specific Gravity = 1.00 to 1.2
- Density 7.75 to 8.5 lbs/USG
- Hydrogen Yield= 0.2 g to 0.4 H_2/g ERD-CH4
- Fermentable carbon @ 65 to 90% weight basis
- AMR 4% to 8% of the FC content
- Soluble organic Fe content 5 to 20% weight basis

Provect ERD-CH4**+** is the only ERD Reagent that includes Provect-CH4® AMR technology in an engineered, pre-mixture formulation to rapidly improve remedial performance while simultaneously minimizing the production of methane. The benefits are notable:

- More Efficient = More Cost Effective: Production of methane is a direct indication that the hydrogen generated from the organic carbon amendments was used by methanogens and the amendment has been wasted because it was not utilized by acetogens or dehalorespiration. By inhibiting the growth and proliferation of methane producing Archaea, chlororespiring bacteria can become the more dominant bacterial populations and at least 15 to >30% less ERD amendment can be applied.
- Safer: Production of methane will result from the addition of any conventional ERD or ISCR amendment: excessive and extended production of methane can result in elevated in groundwater concentrations (as high as 1,000 ppm have been reported) which can lead to accumulation in soil gas subsequently impacting indoor air. State specific regulations for methane in groundwater have been promulgated, with others pending for soil gas and indoor air.
- Green and Sustainable Technology: Formulated with byproducts from "green" energy processes, so it is better for the environment.
- Patented Technologies: Technology end users and their clients are fully protected from all Patent and other legal issues.

- Ease of Use:
    - Completely soluble in water hence no need for extensive and time consuming "water chase".
    - No need to emulsify the product with specialize tooling and equipment
    - No laborious material transfers and dilutions
    - No worry about an emulsion breaking.
    - Lower injection pressures
    - No soap formation from bringing pH up too high
    - ERD-CH4 is formulated for each site-specific application
    - Avoids cost and need for secondary treatment to manage excessive methane production (SVE/AS plus off gas treatment)
- Carbon Longevity (> 2 years): Contains C14 to C18 fatty acids that have been shown in the field to last for over two years. Emulsified oils eventually break down into bioavailable C18 fatty acids through hydrolysis, so we are essentially using the same long-lived components of emulsified oils without having to emulsify or wait for hydrolysis to occur.
- Natural Co-Solvent: includes ethyl lactate which is a "green" co-solvent. This helps dissolve fatty acids, and it also aids desorption of bound COIs to accelerate treatment.
- Cost Competitive: Standard formulations containing 80% fermentable carbon + 5% (FC weight basis) AMR methane inhibitor + 6.5% weight basis DVI is the most cost efficient way of procuring the combined technologies.

OPTIONAL INOCULANTS FOR ERD TREATMENT

If aquifer conditions are not optimal for ERD/ISCR, then the indigenous microbial population may catabolically limited and any ERD remedial process will benefit from the addition of inoculants with known abilities to rapidly biodegrade DCE and related compounds. Once favorable redox conditions (ca. ORP < -100 mV, DO <1 mg/L, pH between 6.5 and 7.5) have been attained DHC cultures can be added to enhance complete mineralization and minimize DCE stalls. The DHC inoculant should contain at least 1x10E11 cfu/L of live bacteria including high numbers of *Dehalococcoides* species with known abilities to biodegrade DCE. The target density of DHC cells in the treated aquifer area should be >1x10E6 cfu/L.

OPTIONAL USE OF BUFFERING AGENTS

For ERD and ISCR to be most effective, aquifer pH should be near neutral or between 6 and 8. The aquifer pH is acidic and an alkaline buffering agent such as $CaCO_3$-based solid materials (*e.g.*, pulverized limestone or dolomite powders) or liquid buffer such as solutions of $Ca(OH)_2$, $Mg(OH)_2$, or $NaHCO_3$ will be applied.

Technical Data Sheet

Provect-OX®

Self-Activating ISCO / Enhanced Bioremediation Reagent

TECHNOLOGY DESCRIPTION

Provect-OX is an *in situ* chemical oxidation (ISCO) / enhanced bioremediation reagent that uses ferric iron (Fe III) as a safe and effective means of activating persulfate (US Patent No. 9,126,245; patents pending). Provect-OX oxidizes a wide variety of organic compounds present in impacted soil, sediment and groundwater, including chlorinated solvents, petroleum hydrocarbons, and pesticides. Rodriquez *et al., (*2014) recently reported that 2 mM Fe(III) and 6 mM persulfate was very effective in rapidly mineralizing even recalcitrant organic compounds such as the synthetic azo dye Orange G ($C_{16}H_{10}N_2Na_2O_7S_2$).

Provect-OX is the only ISCO technology designed to actively manage rebound. The advanced activation catalyst is further unique considering its ability to enhance bioremediation processes. This is accomplished via the subsequent utilization of sulfate and iron as terminal electron acceptors for facultative reductive processes. Degradation intermediates generated during pollutant oxidation may act as electron shuttles, allowing the reduction of Fe(III) to Fe(II) in the redox cycling of iron and continued activation of persulfate. This combined remedy provides supplemental treatment mechanisms thereby allowing for more cost-efficient dosing of the product.

Like all Provectus products, Provect-OX was developed by experienced practitioners who understand real-world field applications. For example, persulfate oxidant and its activator are conveniently packaged in a single, pre-mixed bag for ease of use and safe handling. Moreover, due to its safe and non-extreme activation chemistry, Provect-OX will not generate excessive heat / off-gases, nor will it mobilize heavy metals or lead to the generation of secondary impact issues, such as elevated arsenic, chromium, or pH.

TRADITIONAL ACTIVATION CHEMISTRIES

Heretofore, sodium persulfate has been activated via heat, chelated metals, hydrogen peroxide, ZVI/surface catalysis and/or pH extremes in order to generate sulfate radicals, hydroxyl radicals, etc. (Tsitonaki *et al.,* 2010). Not only do these systems require the addition of other products or energy, they tend to disregard the many biologically mediated processes possible as a consequence of the decomposition products of persulfate.

Divalent metal activation: The utilization of ferrous iron, usually as a chelated cation consumes the oxidant (persulfate) in a conversion of the ferrous iron to ferric iron. Additionally, the presence of the chelant inhibits biological utilization of the generated ferric species as a biological terminal electron acceptor and consumes oxidant. Over dosing of the chelated ferrous iron further consumes the oxidant.

Caustic Activation: The utilization of caustic (high pH) activation of persulfate presents inherit health and safety issues while creating an unsuitably high pH environment for biological attenuation. Further, within this activation mechanism is a self-limiting biological attenuation process once the pH returns to suitable levels. The sulfate, when used as a

biological terminal electron acceptor, transitions to sulfite and finally sulfide. This final product forms hydrogen sulfide which inhibits further biological activity.

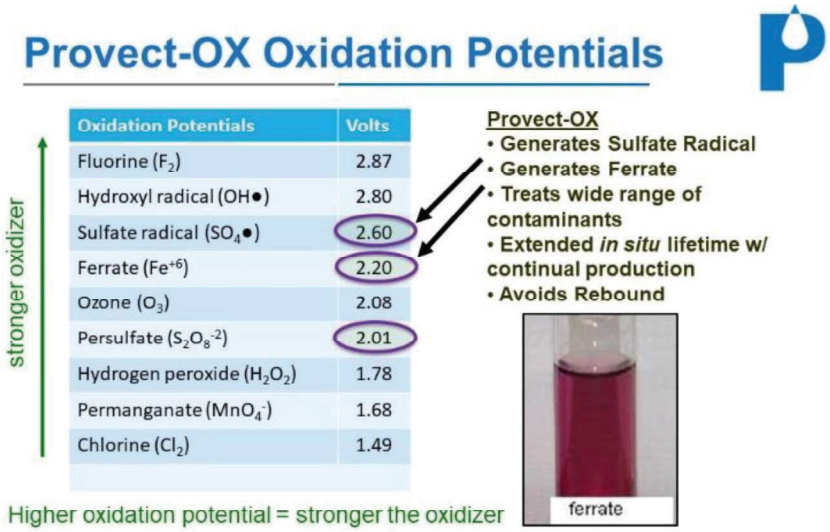
Heat Activation: The utilization of heat as an activation mechanism is generally difficult to implement, and it incurs high implementation costs while not addressing the hydrogen sulfide issue.

Hydrogen Peroxide Activation: The use of peroxide as an activating mechanism again does not address the hydrogen sulfide generation problem while having limited efficacy on many targeted compounds.

MODE OF ACTION

ISCO: Under the Provectus approach, persulfate is activated by Fe III (pre-mixed formulation) which requires a lower activation energy than alternative mechanisms while not consuming the persulfate oxidant. The mechanism is believed to elevate the oxidation state of the iron transiently to a supercharged iron ion which in itself may act as an oxidant. As this supercharged iron cation is consumed, the resulting ferric species can act as a terminal electron acceptor for biological attenuation. Coincidentally, the generated sulfate ion from the decomposition of the persulfate provides a terminal electron acceptor for sulfate reducers which may further remediate the targeted compounds in the groundwater and soils. The reactions that occur in the chemical oxidation include persulfate radicals and ferrate, as summarized below (Equation 1):

$$S_2O_8^{-2} + Fe^{+3} \text{ ---------> } Fe^{(+4 \text{ to} +6)} + SO_4^{2-} + SO_4^{-\bullet} \quad \text{(Eq. 1)}$$



SECONDARY ATTENUATION PROCESS (Biologically Mediated):

1) Sulfate Residual

After dissolved oxygen has been depleted in the treatment area, sulfate (a by-product of the persulfate oxidation) may be used as an electron acceptor for anaerobic biodegradation by indigenous microbes. This process is termed sulfidogenesis and results in the production of sulfide. Stoichiometrically, each 1.0 mg/L of sulfate consumed by microbes results in the destruction of approximately 0.21 mg/L of BTEX compounds. Sulfate can play an important role in bioremediation of petroleum products, acting as an electron acceptor in co-metabolic processes as well. For example, the basic reactions for the mineralization of benzene and toluene under sulfate reducing conditions are presented in equations 2 and 3:

$$C_6H_6 + 3.75\ SO_4^{2-} + 3\ H_2O \rightarrow 0.37\ H^+ + 6\ HCO_3^- + 1.87\ HS^- + 1.88\ H_2S^-$$ (Eq. 2)

$$C_7H_8 + 4.5\ SO_4^{2-} + 3\ H_2O \rightarrow 0.25\ H^+ + 7\ HCO_3^- + 2.25\ HS^- + 2.25\ H_2S^-$$ (Eq. 3)

2) Ferric Iron:

Ferric iron is also used as an electron acceptor during anaerobic biodegradation of many contaminants, sometimes in conjunction with sulfate. During this process, ferric iron is reduced to ferrous iron, which is soluble in water. Hence, ferrous iron may be used as an indicator of anaerobic activity. As an example, Stoichiometrically, the degradation of 1 mg/L of BTEX results in the average consumption of approximately 22 mg/L of ferric iron (or "production" of ferrous iron) as shown below (equations 4-6).

$$C_6H_6 + 18\ H_2O + 30\ Fe^{3+} \text{-------}> 6\ HCO_3^- + 30\ Fe^{2+} + 36\ H^+$$ (Eq. 4)

$$C_7H_8 + 21\ H_2O + 36\ Fe^{3+} \text{-------}> 7\ HCO_3^- + 36\ Fe^{2+} + 43\ H^+$$ (Eq. 5)

$$C_8H_{10} + 24\ H_2O + 42\ Fe^{3+} \text{-------}> 8\ HCO_3^- + 42\ Fe^{2+} + 50\ H^+$$ (Eq. 6)

3) Pyrite Formation:

While ferrous iron is formed as a result of the use of the ferric species as a terminal electron acceptor, residual sulfate is utilized as a terminal electron acceptor by facultative organisms thereby generating sulfide under these same conditions. Together, the ferrous iron and the sulfide promote the formation of pyrite as a remedial byproduct (equation 7). This reaction combats the toxic effects of sulfide and hydrogen sulfide accumulation on the facultative bacteria, while also providing a means of removing targeted organic and inorganic COIs via precipitation reactions. Moreover, pyrite possesses a high number of reactive sites that are directly proportional to both its reductive capacity and the rate of decay for the target organics.

$$Fe^{2+} + 2S^{2-} \text{-------}> FeS_2 + 2e$$ (Eq. 7)

PRIMARY FEATURES:

This technique maximizes the synergy between persulfate and iron for coupled oxidation and enhanced bioremediation: i) sulfate is generated from persulfate, i) Ferric iron (Fe III) is microbiologically reduced to ferrous iron (Fe II) readily supplying electrons to exchange and react with sulfide. Together, sulfide and iron form pyrite, an iron bearing soil mineral with a favorable reductive capacity.

- Effective: Promotes multiple free radical based *in situ* oxidation of a wide-range of organic contaminants. Also provides a unique microbiological component for multiple accelerated attenuation processes.
- Efficient: Significantly lower costs as a result of sub-stoichiometric dosing requirements.
- Safe: Fewer health and safety concerns as compared with use of traditional activation methods such as heat, chelated metals, hydrogen peroxide or pH extremes. Contains built-in activation which eliminates the need for additional and potentially hazardous chemicals required to achieve traditional persulfate activation.

- Ease of Use: Single component product with integrated activator results in simplified logistics and application. No additional containers or multi-step mixing ratios required prior to application. Fewer material compatibility issues.
- Improved Performance: Combined remedy prevents "rebound" which is often seen in other oxidation processes. Maximizes the inherent geochemistry of a "post-oxidation" environment for biologically based attenuation.
- Patented Technology: US Patent No. 9,126,245 (international filings in EU, Australia, Brazil, Canada, China, Colombia, Japan and Mexico) and others pending allow us to freely market this advanced persulfate-based ISCO technology globally, using our choice of suppliers.

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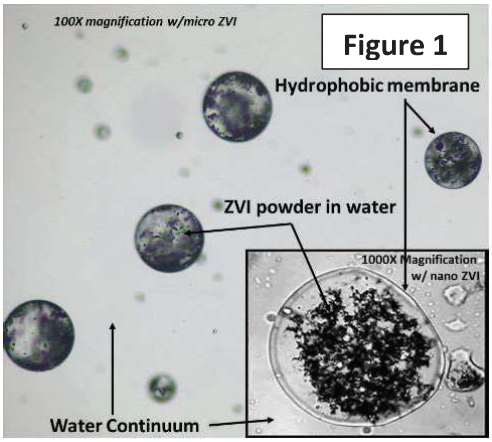
ADVANCED EZVI FORMULATIONS FOR THE REMEDIATION INDUSTRY

Provectus Environmental Products, Inc. offers the most advanced, cost efficient formulations of the NASA patented Emulsified Zero Valent Iron (EZVI) technology to the remediation industry. Millions of pounds of EZVI have been used successfully at locations throughout the United States (including Superfund sites) and in Canada, France and Australia (Reinhart, 2003; Su *et al*., 2017). Provectus' scientists have unmatched experience and expertise with practical formulation, manufacturing, design, and full-scale technology applications.

Provectus' EZVI formulations (**Figure 1**) uniquely contain:

- **Controlled methanogenesis** – safer, more efficient, more effective
- **Lower viscosity** formulations – maximizes subsurface distribution and contact
- **pH stabilized** formulations – optimizes emulsion stability and reactivity
- **Catalyzed ZVI** – enhances reactivity by augmenting electron transfer processes



Additional benefits of our EZVI product offerings include:

Technical

- Quality Assured Products
  - Emulsion structure, density, hydrophobicity
- Proven Effectiveness / Longevity
- Custom Formulations Available
- NASA Patents Recognized and Honored

Economic

- Competitive in situ DNAPL/source destruction technology
- Green & Sustainable product
- Made in the USA (FAR 52.225-11)

INTRODUCTION

The remediation of a dense non-aqueous phase liquid (DNAPL) is complicated by its physical and chemical properties (EPA, 2004). By definition, DNAPLs are compounds that have specific gravities greater than water (> 1 g/cm^3), low water solubility, and therefore, a hydrophobic physical chemistry. The presence of DNAPL at a site can act as an ongoing source of contaminant to groundwater for decades. Chlorinated solvents are present as DNAPLs at many superfund sites (EPA, 2004). The potential effectiveness of ZVI for remediation of groundwater impacted by chlorinated solvents has been documented since the early 1990s (Gillham, 1994). As described by Arnold and Roberts (1998), chemical transformation via ZVI occurs on particle surfaces and therefore involves at least three steps: (a) adsorption of the substrate to reactive sites on the ZVI particle surface, (b) reaction at the surface, and (c) desorption of the transformation product. In the absence of interspecies competition by catabolites, the kinetics of PCE transformation via α-

and/or β-elimination reactions (and, to a lesser degree, hydrogenolysis and hydrogenation reactions) is therefore directly related to reactive surface area.

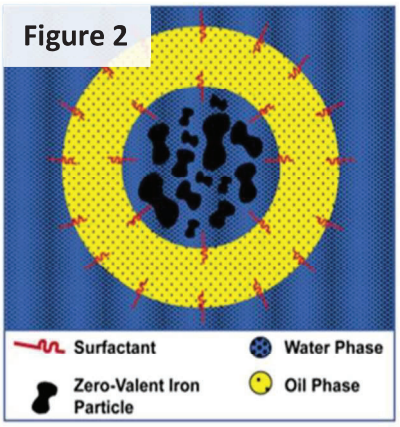
The ZVI mediated transformation processes described above are relevant for dissolved phase contaminant destruction, as the ZVI requires a hydrogen donor (*e.g.* H_2O) for the abiotic reactions to proceed (Brown *et al*., 2009). Because DNAPL is not in the dissolved phase and has a hydrophobic physical chemistry, injection of ZVI slurries into source areas will not provide direct destruction of source material. The EZVI technology provides a solution to this problem, and is engineered to enable maximum contact with source materials, while including ZVI suspended within water (hydrogen donor) so that direct DNAPL destruction is possible using ZVI technology.

ZVI PLUS VEGETABLE OIL IS NOT EZVI

Emulsion Structure

EZVI combines food grade vegetable oil (VO) with a surfactant, elemental iron and water in a specific physical structure to enable direct DNAPL destruction utilizing a combination of abiotic and biotic processes. The key innovation surrounding the EZVI technology is the structure of the emulsion (Quinn *et al*., 2005, Su *et a*l., 2017). In order for the NASA patented technology to perform as designed, the emulsion structure, which is a water-in-oil type emulsification, must be in place (see **Figure 2**). The structure of the EZVI technology enables;

- Miscibility with DNAPLs in situ
- Continuous Sequestration (phase partitioning) of COI into outer VO membrane (decreased COI mass flux)
- Encapsulates ZVI so that it targets only COIs with hydrophobic physical chemistry
- Provides slow release hydrogen source for biostimulation downgradient of source area



DNAPL treatment with EZVI proceeds via 3 primary steps;

- Sequestration (into outer lipophilic membrane)
- Dissolution (into interior aqueous phase)
- Reductive dehalogenation (utilizing abiotic and biotic processes)

Miscibility with DNAPLs

Due to the above structure, the EZVI technology is itself a DNAPL. The outer vegetable oil membrane provides matching hydrophobic physical chemistry such that the remedial emulsion is fully miscible with COI source material in situ (see **Figure 3**). This unique characteristic enables maximum contact with DNAPL materials in situ, which is critical to accomplish direct source material destruction.

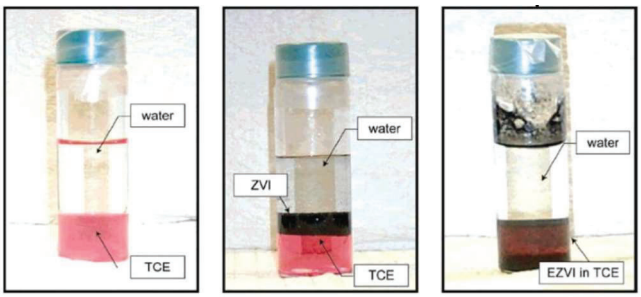
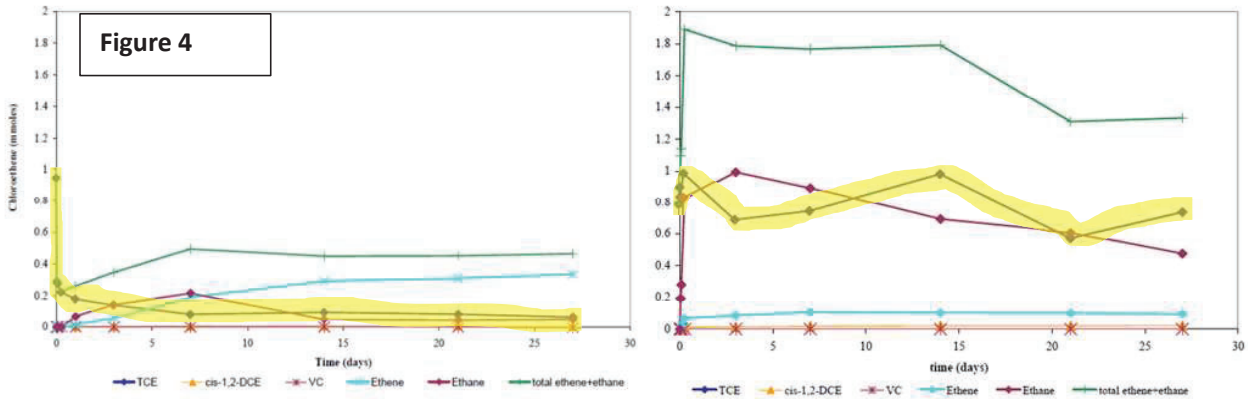


Figure 3 **Miscible with DNAPL**
Ref: Quinn *et al.,* 2009

Decreased Source Area Mass Flux

When the EZVI technology is implemented within a source area, the chemical equilibrium is disrupted and hydrophobic contaminants (*e.g.* chlorinated solvents) phase partition into the vegetable oil membrane of the emulsion. By emplacing this lipophilic membrane within the source area the water solubility of the hydrophobic contaminants is effectively decreased, see Figure 4, where the EZVI microcosm demonstrated a 90% decrease in dissolved TCE concentrations, while the ZVI microcosm showed little change in dissolved TCE concentrations. This is the result of rapid phase partitioning or sequestration of the DNAPL into the outer membrane of the emulsion, and results in dramatically reduced groundwater concentrations which in turn provide significant reduction in contaminant mass flux from an EZVI treated source area.

Figure 4



EZVI and KB-1 DNAPL ZVI and KB-1 DNAPL

Ref: O'Hara et al., 2005

Combined Technologies Abiotic and Biotic Processes

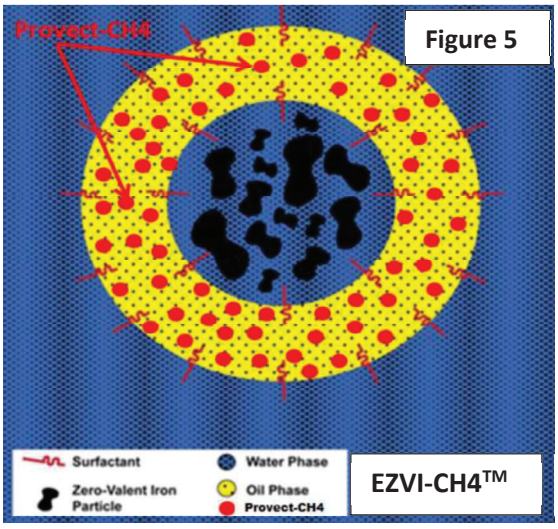
Abiotic reductive dehalogenation processes primarily occur on the interior of the emulsion where the highly reactive ZVI powder is encapsulated with water. This creates a COI concentration gradient across the lipophilic membrane into the interior of the micelles, and continually pulls contaminant mass into the emulsion. The biologically mediated processes are primarily occurring on the outside (exterior) of the emulsion and downgradient (hydraulically) from the treated source area. The outer membrane is a fermentable substrate (vegetable oil) that provides hydrogen for the microbes to utilize, creating biostimulated conditions.

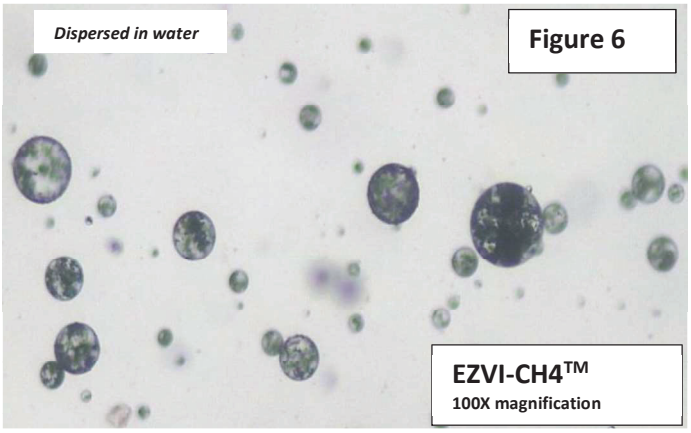
PROVECTUS' EZVI TECHNOLOGY ADVANCEMENTS

DNAPL Destruction with Controlled Methanogenesis - EZVI-CH4™

Chlorinated hydrocarbon source areas typically have microbial populations that are inhibited by high dissolved contaminant concentrations (Brown *et al*., 2009). When the EZVI technology is initially deployed the dissolved phase contaminant concentrations decrease dramatically and substantially (~ 90%) and enable the previously inhibited microbial communities to activate. Due to the ability of methanogens to multiply rapidly, they are typically the dominant hydrogenotrophs found in anaerobic biogeochemical conditions (Bates *et al*., 2011). Due to the decrease in dissolved phase contaminant concentrations that occurs when utilizing the EZVI technology, combined with the ability of methanogens to rapidly multiply, it is common to see elevated methane production in conjunction with EZVI treatments.

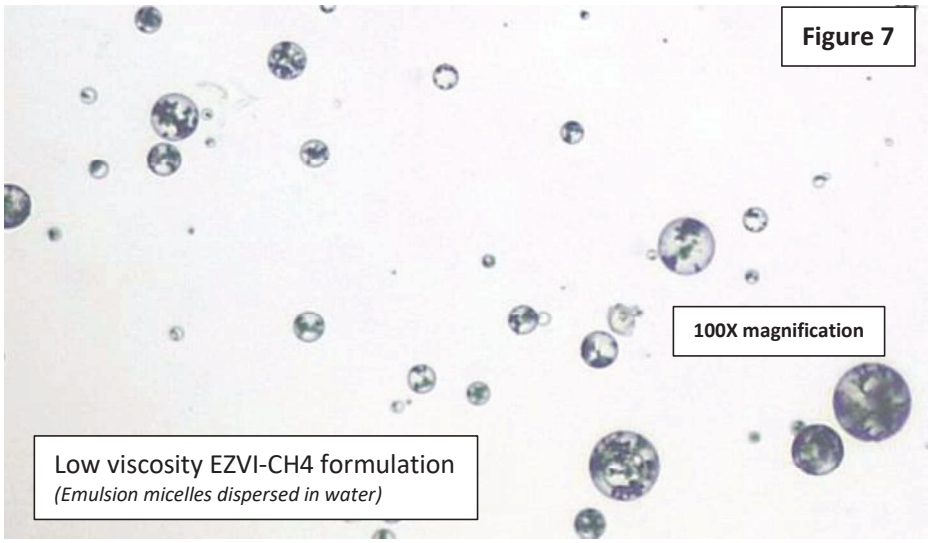
Therefore, Provectus' EZVI-CH4™ combines our patented antimethanogenic technologies (Provect-CH4™), with the EZVI technology to offer the only in situ DNAPL destruction technology with controlled methanogenesis. (Figure 5 & Figure 6). The antimethanogenic chemistry is combined into the fermentable carbon component of the emulsion, so that methanogens are inhibited as the vegetable oil is fermented to organic acids. Multiple types of methane inhibitors are utilized, including RYR extract and select essential oils/saponins. A micrograph image of the EZVI-CH4™ product in water is depicted in Figure 6.





Decreased Viscosity Formulations

The NASA patented formulation for EZVI typically has a viscosity that ranges between 1,200 – 1,900 cP (Quinn et al., 2005). This level of viscosity has been problematic during implementation dependent on soil conditions and the implementation method (e.g. injection equipment). In order to maximize subsurface distribution, and therefore contact with source materials, Provectus has developed a lower viscosity formulation of the EZVI technology that retains the correct emulsion structure and stability (Figure 7). This new formulation has a viscosity that ranges from 700 - 900 cP.



pH Stabilized and Catalyzed Formulations

The reaction kinetics of unamended ZVI with chlorinated solvents is pH dependent and inversely correlated (Chen et al., 2001). As ZVI reacts with water the surface of the ZVI is passivated by the deposition of iron oxides and oxyhydro-oxides (Liu et al., 2006). Also, the pH of the water is increased due to the formation of hydroxyl ions. The increased pH conditions in turn enhances the rate of passivation of the iron surface due to formation of oxidized iron species. Additionally, the non-ionic surfactant used to manufacture the EZVI emulsion, is less stable with increasing pH conditions and could result in decreased emulsion stability under certain conditions in the aqueous phase of the emulsion (e.g. pH > 9.5).

Therefore, Provectus has formulated pH stabilized and catalyzed EZVI products which contain additives that will hydrolyze and provide acidity over time to the interior of the micelle. In addition, additives that will catalyze ZVI electron transfer processes, as well as, act to directly reduce iron oxides on the ZVI surfaces. These additives function to extend the duration of more optimal conditions for abiotic reductive dehalogenation reactions to occur, and prevents the potential destabilization of the emulsion due to elevated pH conditions.

KEY FEATURES

- Emulsion Structure: Water drops dispersed within vegetable oil (water-in-oil)
- Viscosity: Low Vis formulation ~ 800 cP; standard formulations ~ 1,500 cP
- ZVI particle size = sub-micron to <5 micron
- Custom Formulations Available (ZVI: 5 to 20%; VO: 35-40%; AMR varies; weight basis)
- Shipping sizes (55 USG drums, 275 USG totes)
- Injection ready: Product is injection ready when received, does not require dilution

CONCLUSIONS

The NASA patented EZVI technology is an elegant solution to the problem of *in situ* DNAPL destruction. However, the water-in-oil structure of the EZVI technology is **critical** for achieving direct DNAPL destruction via ISCR processes. Provectus EZVI products **are not** simply a mixture of emulsified vegetable oil (oil dispersed in water type emulsion) and ZVI. Rather, our EZVI products are the most advanced formulations of the NASA patented technology, and include;

- **CONTROLLED METHANOGENESIS** – EZVI-CH4™ is manufactured using Provectus' patented antimethanogenic reagents (AMR) technology incorporated into the fermentable component of the emulsion to inhibit excessive methanogenesis from occurring during initial fermentation of emulsion materials.
- **CATALYZED ZVI REACTIONS** – Our EZVI and EZVI-CH4™ can be provided with catalyzers to enhance and extend the reactivity of ZVI particles.
- **ENHANCED EMULSION STABILITY**- Our EZVI and EZVI-CH4 ™ can be provided with pH stabilization to maintain interior pH levels so that the emulsion structure has prolonged reactivity/stability in the subsurface.
- **LOWER VISCOSITY EMULSION** – PEP-EZVI and EZVI-CH4™ can be engineered, when appropriate, with decreased viscosity characteristics for enhanced installation (i.e. injectability).
- **CUSTOM EMULSION FORMULATION** – PEP-EZVI and EZVI-CH4™ is custom formulated for ZVI percentage, ZVI catalysis, AMR percentage, and viscosity, for each site. We will review your site information and work with you to develop a formula that is adapted for attaining your site-specific remediation goals.
- **EMULSION INTEGRITY** – Our EZVI products are manufactured per the NASA patent and quality checked during manufacturing to ensure emulsion structure is correct.

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Turn-Key, Risk-Reward, Pay-for-Performance, Remedial Guarantees/Warranties

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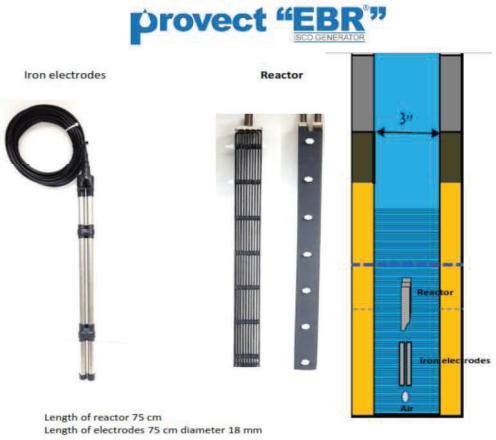
Provect-"EBR®" - *In Situ* Generator of Reactive Oxidants

Technology Description

Provect-"EBR®" is an *in situ* electrokinetic system that continually generates both Fenton's reagents and dissolved oxygen at a neutral pH without the addition of any external chemicals. Provect-"EBR®" is a field proven system that effectively integrates *in situ* chemical oxidation (ISCO), microbiological, and geophysical mechanisms to remediate contaminated aquifers. Targeted constituents of interest (COIs), including petroleum hydrocarbons and chlorinated solvents, are destroyed via multiple oxidation reactions and accelerated biodegradation using oxygen and iron as the preferred electron acceptors. The remediation system is monitored in real-time and controlled remotely via a user-friendly dashboard interface, which allows for the collection of field data, report generation, and operation maintenance updates.



Mode of Action

Under variable electric fields, the Provect-"EBR®" system employs catalytic electrodes to continuously generate molecular oxygen from water while releasing iron cations via forced corrosion of installed iron electrodes. This creates reactive oxidant species at a neutral pH, such as hydrogen peroxide (H_2O_2), superoxide (O_2), hydroxyl radicals (OH^-), ferrate (Fe^{4+}, Fe^{5+}, and/or Fe^{6+}), along with low Fermi level (oxidized) iron oxyhydroxides. As these reactants migrate through the formation and the iron oxyhydroxides within the aquifer equilibrate their Fermi level electrochemical potentials, they continuously catalyze and generate new oxidizing species that subsequently destroy COIs via chemical oxidation. Additionally, residual oxygen and iron serve as electron acceptors for to sustain biodegradation.

Key Features

- Effective: Promotes multiple oxidation reactions without the addition of any outside chemicals on a wide range of COIs (e.g., petroleum hydrocarbons, chlorinated solvents, VOCs, SVOCs, pesticides, emerging contaminants, etc.). Offers a unique microbiological component for sustained secondary bioremediation.
- Cost-efficient: Low capital cost, solar power options, low maintenance, and no external chemicals.
- Improved Performance: System is designed to be deployed in a wide array of settings, including source areas, dilute plumes, deep and shallow aquifers, and mixed lithologies.
- Ease of Use: Control panel and specialized software allows for real-time monitoring and remote systems operations.
- Safety: The catalytic electrodes are placed into the subsurface aquifer, thus not negatively impacting any utilities or subsurface infrastructure in the overlying vadose soil.

Provect-"EBR®" is patented in the United States (U.S. Patent 9,975,156 B2) by E. Elgressy Ltd. Provectus Environmental Products, Inc. is an exclusive provider of the Provect-"EBR®" technology within the United States.

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APPENDIX B

EZVI and Provect-IR™ - *In Situ* Chemical Reduction (ISCR) Reagents for Source Area and Dissolved Plume Destruction

Former Manufacturing Facility – East Orange, NJ
Constituents of Interest: Trichloroethylene, cis-1,2-Dichloroethene and Vinyl Chloride
Lead Contractor: Innovative Environmental Technologies, Inc. (IET)

Project Summary

Soil and groundwater at a former manufacturing facility in East Orange, NJ were impacted by trichloroethylene (TCE), cis-1,2,dichloroethene (cis-1,2-DCE) and vinyl chloride (VC) due to historical releases. The geology of the impacted matrix was primarily red-brown clayey silts with some occasional layers of fine sands. TCE concentrations in groundwater were as high as 99.1 mg/L. In November 2015, Innovative Environmental Technologies, Inc. (IET) implemented an in situ chemical reduction (ISCR) remediation program to enhance both abiotic and biological reductive processes (U.S. Patent #7,531,709). The primary goal of the remediation program was to limit plume migration to downgradient areas. The injection program included the application of emulsified zero valent iron (EZVI) to destroy source mass and minimize contaminant flux, ZVI, Provect-IR™, and additional site-specific reagents including kelp and Vitamin B12, to enhance abiotic and biotic reductive dechlorination processes. During November 2015, a total of 43 direct push injection points were utilized to distribute the approxmately 6,435 gallons of remedial solutions within the targeted treatment areas (**Figure 1**).

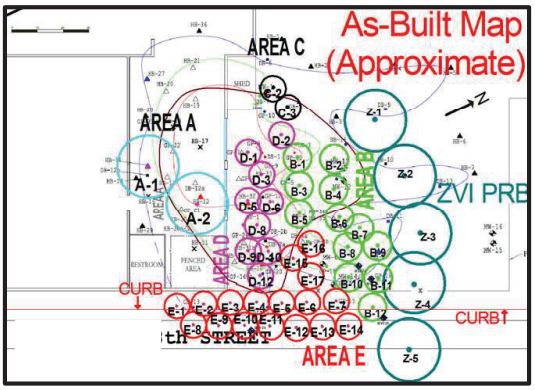


Figure 1. Treatment Areas

Treatment Program Results

During the baseline sampling event, 10 monitoring wells were sampled within and adjacent to the targeted treatment area. Eight of those wells (MW-1, MW-2, MW-12, MW-13, MW-14, MW-21 MW-22, and MW-23) are located within treatment areas targeted during the remedial injection event, while monitoring wells MW-15 and MW-16 are located to the northeast and hydrologically downgradient of the targeted treatment areas. Several post-treatment samples have been collected and analyzed for the targeted volatile organics and relevant geochemical conditions since the baseline sampling event to evaluate treatment program progress. Field parameters were also evaluated during groundwater sample collection. Overall, all monitoring wells have recorded considerable decreases in TCE concentrations. Specifically, TCE concentrations have decreased to below laboratory detection limits in monitoring wells MW-1, MW-12, MW-13, MW-14, MW-21 and MW-16, while in monitoring locations MW-2, MW-12, MW-23 and MW-15 it has decreased by 96%, 93%, 99% and 58%, respectively.

Due to the amount of available data, two representative wells were selected for site summary discussion; however, the comprehensive project analysis with individual monitoring well data sets can be provided.

MW-12 Location, Field Parameters and Geochemical Data: Monitoring well MW-12 is located slightly north of injection point B-4 (**Figure 2**) and is screened from 16.6 to 26.6 ft bgs. The field parameters and the geochemical data for monitoring well MW-12 are presented in **Table 1** below.

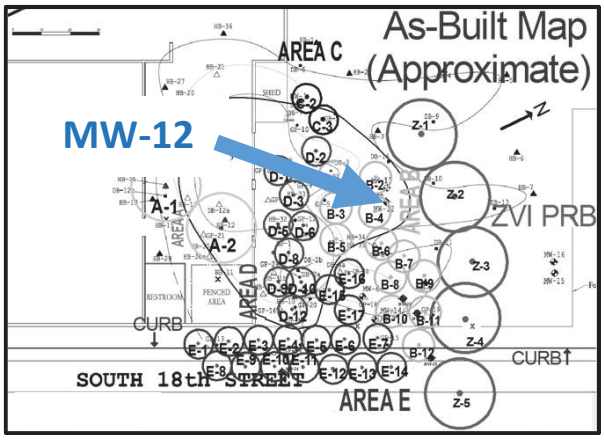


Figure 2. Location of MW-12

The post-treatment groundwater pH values are neutral at 6.49 units, which is within the optimal range for dehalogenic bacteria to operate efficiently. The ORP has maintained strongly reducing conditions that were established immediately after the completion of the injection. The dissolved sulfate and total iron concentrations remain decreased indicating that sulfate and iron reduction processes are ongoing. The concentrations of dissolved gases continue to increase, which suggests that methanogenic and dehalogenic activities are occurring, and that methanogenesis is controlled. Based on data, the biogeochemistry appears to have been very favorably impacted by the remedial injection and the subsurface conditions remain conducive for reductive dechlorination processes to proceed.

Table 1. Field Parameters and Geochemical Data for MW-12.

MW-12						
Sampling Date	05/13/2015	12/11/15	05/26/16	08/29/16	12/21/16	07/18/17
Depth to GW (ft)	20.43	23.95	21.34	22.02	23.28	19.35
D.O. (mg/L)	3.72	<0.01	1.38	8.16	6.93	3.21
ORP (mV)	+113	-57	-166	-99	-147	-106
Conductivity (uohms/Con)	2,310	2,390	2,460	2,360	2,340	2,220
pH	7.20	7.54	6.65	6.71	6.13	6.49
Sulfate (mg/L)	50.5	34.8	<10	NA	<10	4.6
Total Iron (µg/L)	8,160	13,200	16,100	NA	30,000	4,900
Methane (µg/L)	12.9	3.5	1,600	NA	1,440	3,410
Ethane (µg/L)	0.82	0.26	86.7	NA	60.9	71.9
Ethene (µg/L)	1.8	0.79	348	NA	1,170	2,170

MW-12 CVOC Data: During July 2017, the concentration of TCE decreased below laboratory detection limits (e.g. <5.3 µg/l). As expected, concentrations of the daughter compounds displayed increases in their respective concentrations during the first four post-injection sampling events; however, during the July 2017 sampling period, and as the reductive dechlorination reaction chain progresses, they have shown considerable decreases.

Specifically, the concentration of cis-1,2-DCE is currently at a new historic low and has decreased by 92% since the baseline sampling event. The concentration of vinyl chloride remains slightly above its baseline sampling measurements; however, recent sampling results indicate 86% reduction compared to its December 2016 sampling value.

Figure 3. MW-12 CVOC Data

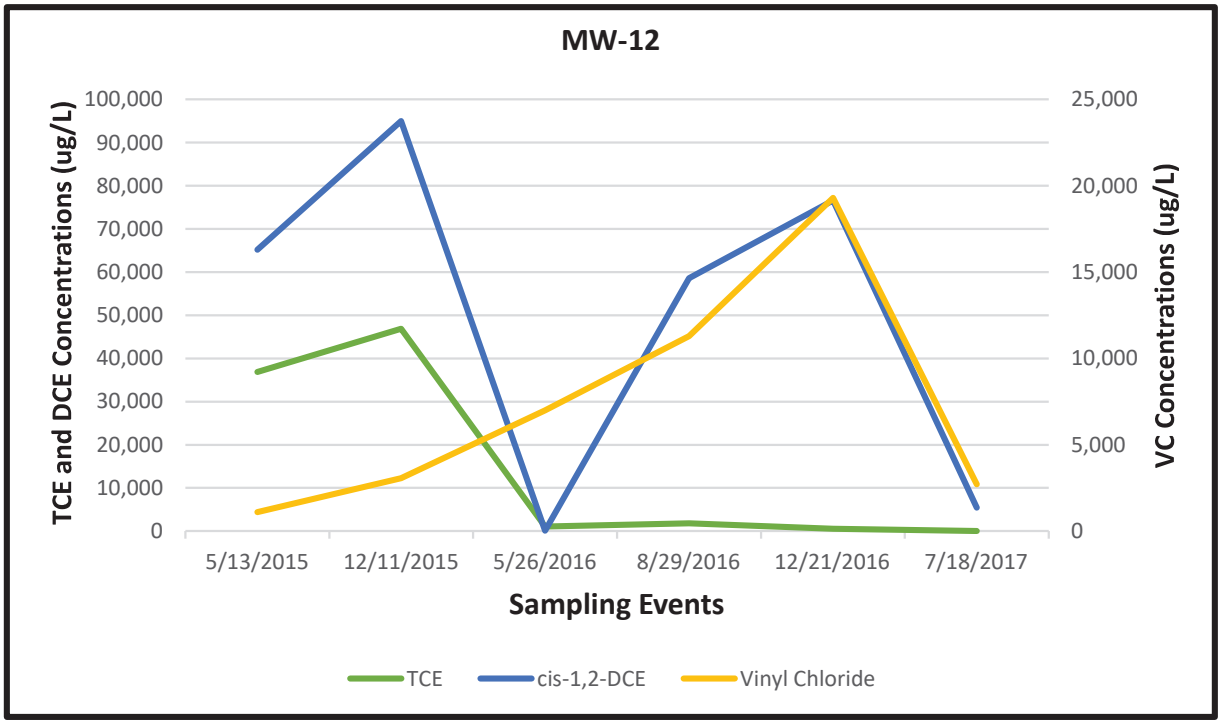


Table 2. CVOC Data for MW-12 (µg/L).

MW-12						
Sampling Date	05/13/2015	12/11/15	05/26/16	08/29/16	12/21/16	07/18/17
TCE	36,900	46,900	1,060	1,790	550	<5.3
cis-1,2-DCE	65,200	95,000	73.400	58,600	76,600	5,420
Vinyl Chloride	1,100	3,060	7,000	11,300	19,300	2,710

MW-21 Location, Field Parameters and Geochemical Data: Monitoring well MW-21 is located near injection point E-5 (**Figure 3**) and it is screened between 14.5 to 24.5 ft bgs. The field parameters and the geochemical data for monitoring well MW-21 are presented in **Table 3** below.

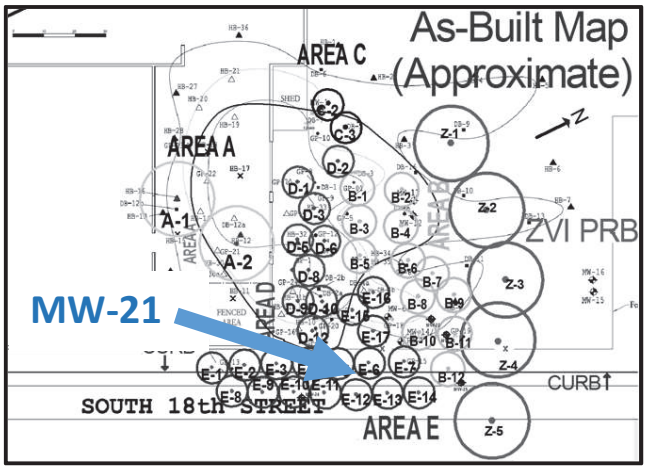


Figure 4. Location of MW-21

The post-treatment groundwater pH values are near neutral at 6.30 pH units. The ORP measurements have maintained reducing values at -78 mV, while conductivity measurements have exhibited increasing values post injection. The trends exhibited by these parameters suggest that remedial injectate continues to influence this area of the site and create biogeochemical conditions favorable for reductive dechlorination processes to proliferate.

Since the November 2015 injection, total iron concentrations have been highly elevated and most recently remain well above baseline levels (e.g. > 9 times above baseline). The decreased concentration of sulfate indicates the formation of pyrite and elevated concentrations of the dissolved gases methane, ethane and ethene, suggests that the fermentable material is still present in the area around MW-21. Furthermore, methanogenesis is being controlled and anaerobic reductive dechlorination processes are currently ongoing.

Table 3. Field Parameters and Geochemical Data for MW-21.

MW-21						
Sampling Date	05/13/2015	12/11/15	05/26/16	08/29/16	12/20/16	07/18/17
Depth to GW	18.73	20.84	19.42	19.85	20.69	18.58
D.O. (mg/L)	7.91	7.21	1.48	1.61	5.54	3.82
ORP (mV)	+19	-92	-38	-102	-150	-78
Conductivity (uohms/Con)	706	614	1,050	1,590	4,460	3,070
pH	7.58	8.92	6.22	6.17	5.86	6.30
Sulfate (mg/L)	11.9	11.6	<10	NA	<10	<2.0
Total Iron (µg/L)	3,200	71,400	23,400	NA	19,200	28,000
Methane (µg/L)	ND	0.53	844	NA	1,120	3,270
Ethane (µg/L)	ND	ND	57	NA	49.3	61.5
Ethene (µg/L)	ND	ND	82.8	NA	300	678

NA: Not Analyzed; ND: Not Detected

MW-21 CVOC Data: Groundwater TCE concentrations continue to exhibit decreasing trends and during the July 2017 sampling period it was measured at below laboratory detection limits.

Daughter product formation resulted in an ephemeral spike in groundwater concentrations of cis-1,2 DCE and vinyl chloride, but since August 2016 the concentration of cis-1,2-DCE has decreased by 28%, while the concentration of vinyl chloride has decreased by 58% since December 2016. Based on the geochemistry that has been established near MW-21, it is anticipated that concentrations of all chlorinated compounds will continue to decrease.

Figure 5. MW-21 CVOC Data

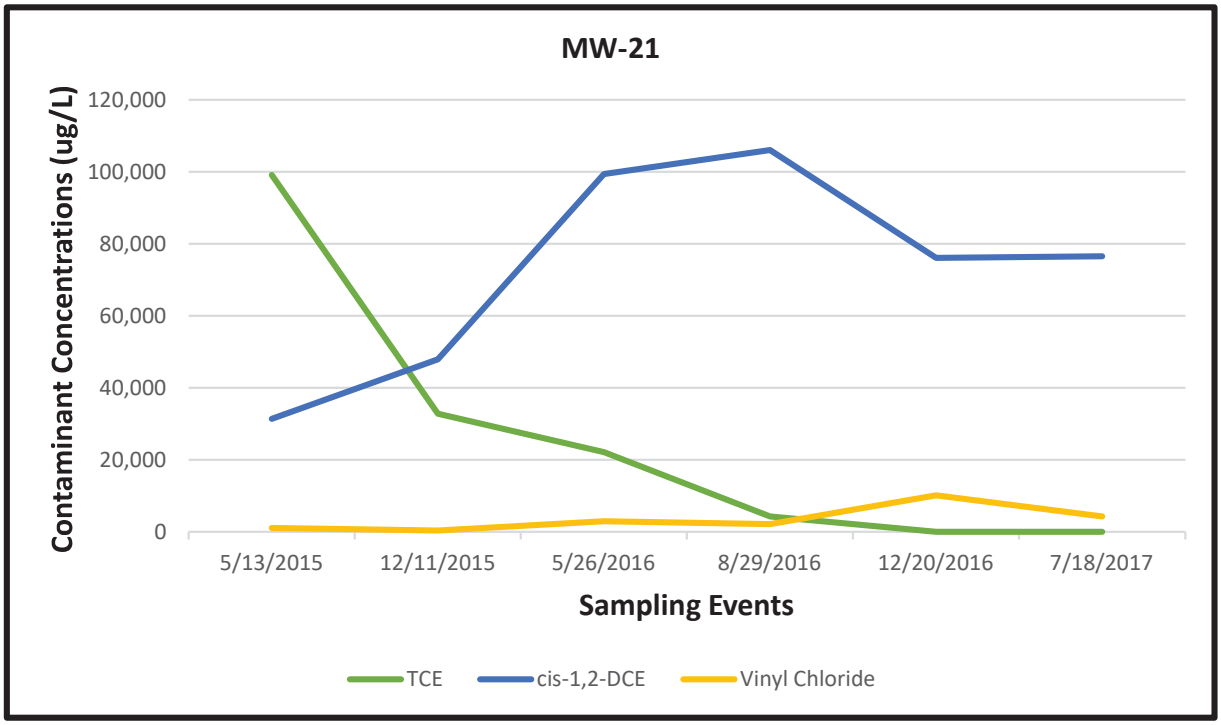


Table 4. CVOC Data for MW-21 (µg/L).

MW-21						
Sampling Date	05/13/2015	12/11/15	05/26/16	08/29/16	12/20/16	07/18/17
TCE	99,100	32,800	22,100	4,280	330 J	<53.0
cis-1,2-DCE	31,400	47,900	99,400	106,000	76,100	76,500
Vinyl Chloride	1,080	375	2,930	2,140	10,100	4,290

Project Conclusions

Based on the groundwater monitoring data, the combination approach utilizing applications of EZVI, ZVI, and Provect-IR™ is very effectively decreasing concentrations of all chlorinated compounds. The injected material was successful in establishing and maintaining pH values within a circumneutral range, while simultaneously decreasing both the dissolved oxygen concentrations and ORP. The elevated conductivity measurements provide additional indications of subsurface injectate distribution and influence.

Overall, all monitoring wells have recorded considerable decreases in TCE concentrations. Specifically, TCE concentrations have decreased to below laboratory detection limits in monitoring wells MW-1, MW-12, MW-13, MW-14, MW-21 and MW-16, while in monitoring locations MW-2, MW-12, MW-23 and MW-15 it has decreased by 96%, 93%, 99% and 58%, respectively.

Due to the ongoing anaerobic reductive dechlorination reaction chain, an increase in the concentrations of the daughter products cis-1,2-DCE and vinyl chloride was initially observed in almost every well; however, those temporary increases have subsided and the concentrations of the daughter products in most of the wells have decreased below their respective baseline sampling values.

Overall the geochemistry of the subsurface has been favorably impacted by the injection event and the environment is currently supporting anaerobic reductive dechlorination reactions. Therefore, it is anticipated that the concentrations of the remaining contaminants will continue to decrease during the upcoming sampling events.

Please contact our office at (815) 650-2230 or via email at info@provectusenv.com for additional information regarding this project or our technologies.

Provect-IR® – *In Situ* Chemical Reduction (ISCR) Reagents for Source and Dissolved Plume Remediation

Former Dry Cleaner – Ocean City, New Jersey
Contaminants of Interest – Tetrachloroethylene (PCE), Trichloroethylene (TCE), cis-1,2-Dichloroethene (cis-1,2 DCE), and Vinyl Chloride (VC)

Project Summary

A former print shop and dry cleaner located in a residential Ocean City, New Jersey neighborhood was contaminated due to previously conducted business related activities. Soil and groundwater were impacted with tetrachloroethylene (PCE), trichloroethylene (TCE), cis-1,2-dichloroethene (cis-1,2 DCE), and vinyl chloride (VC). Limited soil excavation was conducted inside the former dry cleaner, but elevated chlorinated volatile organic compound (CVOC) concentrations continued to persist in groundwater. The subsurface geology consisted of coarse sand to a depth of 5 feet below ground surface (ft bgs) followed by a peat layer to a depth of 8 ft bgs. Groundwater is tidally influence with an average depth of 4 ft bgs. Reducing groundwater geochemical conditions were present at the site likely due to anoxic conditions formed within the peat layer. Additional source excavation coupled with soil mixing utilizing an *in situ* chemical reduction (ISCR) amendment, specifically Provect-IR®, was selected to complete source removal and ensure residual contaminant mass was addressed.

Provect-IR® is a site-specific blend of unique reagents combined into a single product that optimizes the *in situ* reductive dechlorination of chlorinated VOC contamination in both soil and groundwater. This technology works by promoting synergistic interactions between zero valent iron (ZVI), hydrophilic, nutrient rich organic carbon sources, chemical oxygen scavengers, vitamins, and mineral sources. This patented combination of natural and food grade amendments promotes ISCR conditions for rapid and effective destruction of the targeted contaminants. Additionally, Provect-IR® is the only ISCR reagent to simultaneously inhibit the production of methane during the requisite carbon fermentation process, which promotes more efficient use of the hydrogen donor while avoiding negative drawbacks associated with elevated methane.

Figure 1: Provect-IR® Applied to Excavation

Remediation Plan

The soil mixing remedial program was designed by Provectus Environmental Products, Inc. (Provectus) in collaboration with Enfuse Environmental, LLC (ENFUSE). Following excavation of the shallow soil impacts, a total of 6,000 lbs of Provect-IR® was applied to the base of the approximate 700 sq ft excavated area with soil mixing conducted to ensure contact with the impacted groundwater. Injection laterals were placed within the backfill material zone as a contingency to apply additional liquid reagents if remedial goals were not achieved. The excavation and Provect-IR® soil mixing remedial program targeted three primary wells, MW-2, MW-4, and MW-8. All monitoring wells remained in-place during excavation and soil mixing activities. Backfill of the excavated area and general site restoration occurred following source removal and blending activities.

Treatment Program Results

The geochemical data from the three performance wells indicate expected results and confirm successful soil blending and reagent distribution of Provect-IR® within the treatment area. Reducing conditions were rapidly observed, with reductions in DO and ORP one-month post-application. After 4 months, ORP continued to decrease and indicated strongly reducing conditions.

Table 1: ORP Data

ORP (mV)				
	Baseline	**1 Month**	**2 Months**	**4 Months**
MW-2	NA	-160	-66	-202
MW-4	NA	-106	-44	-172
MW-8	NA	-121	-52	-153

The monitoring wells with the highest VOC concentrations, MW-2 and MW-8, saw significant contaminant reductions, with each constituent being reduced by at least 90% at five months post-application. Parent compounds PCE and TCE at MW-2 have decreased by 99% and 97%, respectively, while MW-8 did not have parent compounds present. Daughter product reductions at both wells range between 90% to 94% for MW-2 and greater than 99% for MW-8. Contaminant reductions at MW-4 were also significant with each individual constituent being reduced by at least 74%.

Table 3: MW-2 CVOC Data (ug/L)

MW-2						
Sampling Timeframe	**Baseline**	**1 Month**	**2 Months**	**4 Months**	**5 Months**	**Reductions**
cis-1,2-DCE	1,800	230	340	300	100	**94.4%**
PCE	920	22	550	82	6.1	**99.3%**
TCE	450	28	200	82	11	**97.6%**
VC	360	220	160	58	36	**90.0%**

Figure 2: MW-2 CVOC Data

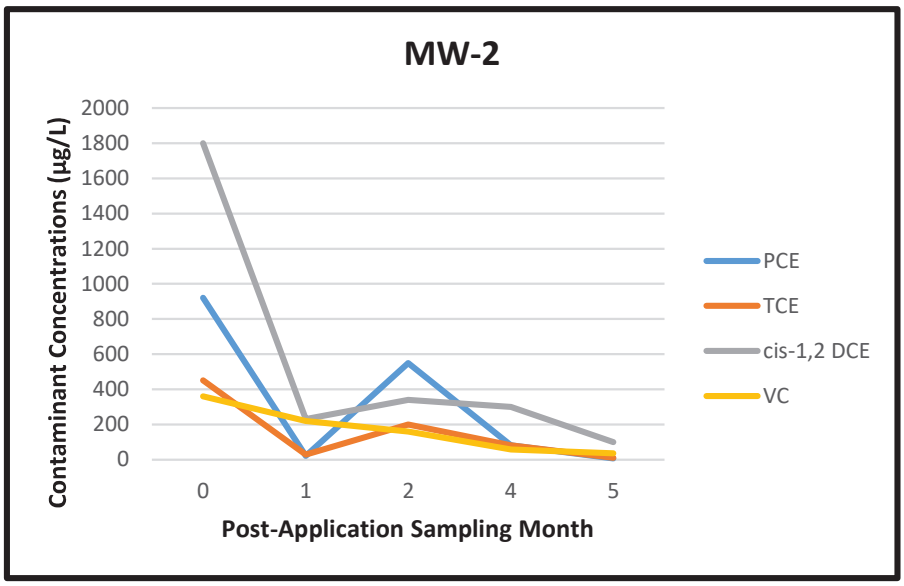
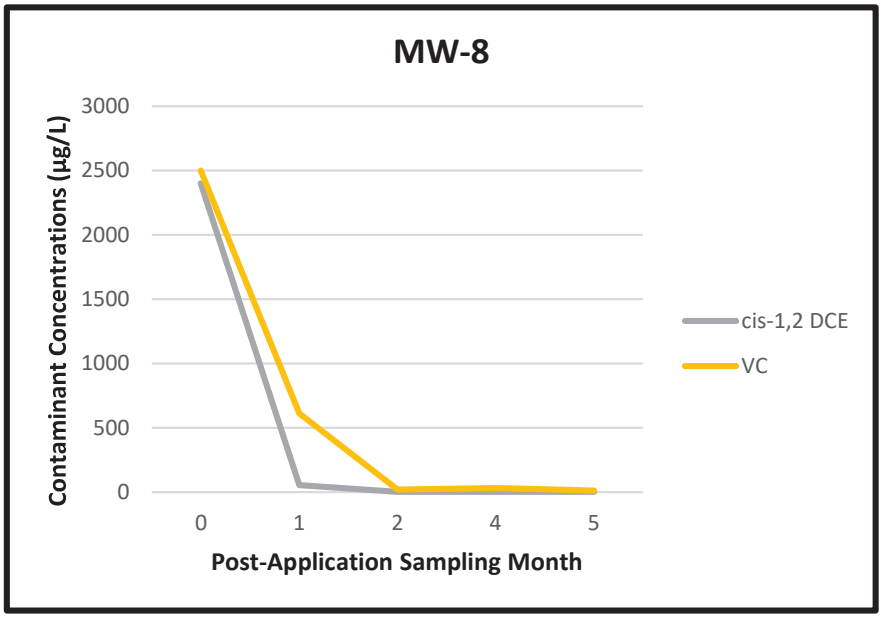


Table 4: MW-8 CVOC Data (ug/L)

MW-8						
Sampling Timeframe	**Baseline**	**1 Month**	**2 Months**	**4 Months**	**5 Months**	**Reductions**
cis-1,2-DCE	2,400	54	1.9	1.4	0.55	**100.0%**
PCE	ND	ND	ND	ND	ND	-
TCE	ND	ND	ND	ND	ND	-
VC	2,500	610	20	32	11	**99.6%**

Figure 3: MW-8 CVOC Data



Lastly, small increases in ethene and ethane were observed in all three target wells, which would be anticipated and is a positive indication of remedial activity in the subsurface. No significant increases in methane were observed, which is due to the antimethanogenic reagents that are included with this site-specific Provect-IR® blend. Based on the current site geochemical conditions, it is expected that the concentrations in the monitoring wells will continue to decrease over future sampling events.

Figure 4: Soil Mixing and Injection Laterals

Please contact our office at (815) 650-2230 or via email at info@provectusenv.com for additional information regarding this project or our technologies.

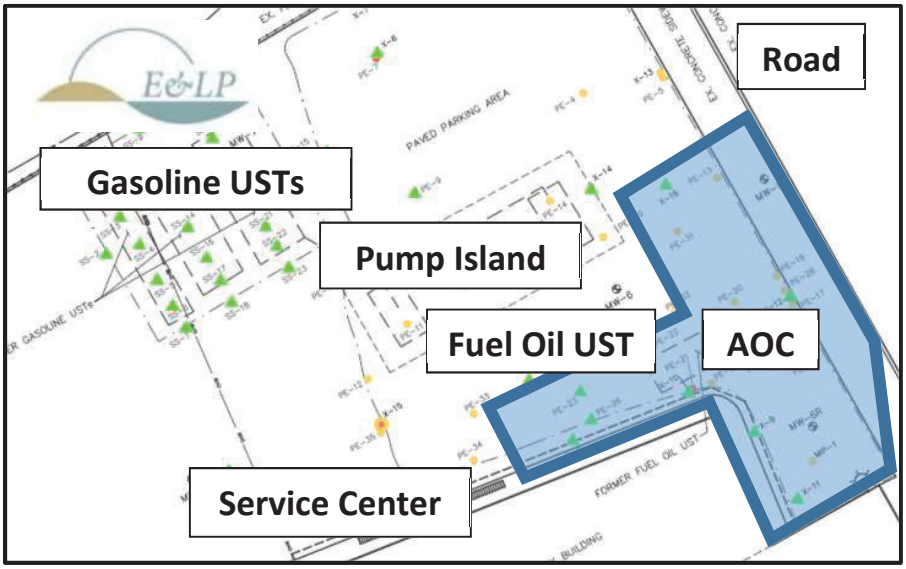
Provect-OX® - *In Situ* Chemical Oxidation + Enhanced Bioremediation for Source Area Remediation

Former Gasoline Station – Madison, New Jersey
Contaminants of Interest – LNAPL, BTEX, and TMB

Project Summary

At a former gas station in Madison, New Jersey, *in situ* remediation was applied to address petroleum hydrocarbon source mass within the subsurface smear and saturated zones. Excavation of gasoline and fuel oil underground tanks (USTs) along with the associated piping and shallow hydrocarbon soil impacts had previously been completed. However, excavation was impacted due to accessibility limitations from the service center building and road. Following excavation and enhanced fluid recovery activities, residual benzene, toluene, ethylbenzene, xylene (BTEX), trimethylbenzene (TMB), and light non-aqueous phase liquid (LNAPL) impacts remained. The primary area of concern (AOC; **Figure 1**) was approximately 1,500 sq ft with a 15-ft vertical target interval from approximately 25 to 40 feet below ground surface (bgs). The geology at the site is dense silt and clay with depth to groundwater at 30 ft bgs**.** The *in situ* injection program targeted the BTEX, TMB, and LNAPL with Provect-OX® (US Patent 9,126,245), which is a catalyzed chemical oxidation process that leverages enhanced bioremediation post-oxidation.

Figure 1: Site Map



Remediation Plan

The remedial program was developed by Engineering & Land Planning Associates, Inc. (E&LP) and Provectus Environmental Products, Inc. (Provectus) with *in situ* implementation provided by Innovative Environmental Technologies, Inc. (IET). A total of 8,500 lbs of Provect-OX® were applied via 12 temporary direct push injection locations to treat the AOC and two impacted monitoring wells. The service center remained open and active during drilling and injection activities.

Provect-OX® rapidly oxidizes the organic contaminants present in soil and groundwater and provides long-term, sustained secondary bioremediation to manage residuals and prevent contaminant rebound. This is accomplished by using ferric iron (Fe III) as a safe and effective means of activating persulfate, which quickly yields sulfate and ferrate (site-specific) radicals for chemical oxidation treatment. A pH buffer is also preblended with the Provect-OX® to offset any post-injection acidic pH conditions that are normally observed with traditional persulfate applications. The technology process enhances subsequent utilization of sulfate and iron as terminal electron acceptors for facultative redox reactions to support secondary biodegradation of any residual contaminant mass.

Treatment Program Results

Field and geochemical data for the two target monitoring wells are presented below in **Table 1** and **Table 2**. Volatile organic compound (VOC) data for the monitoring wells are presented in **Table 3** and **Table 4**. Chemical oxidative conditions are evident during the first MW-6R and MW-9 post-treatment sampling event with increased ORPs of +354 mV and +32.6, respectively. The presence of persulfate, sulfate, and iron in groundwater confirmed that Provect-OX® was successfully distributed within the targeted area. The included pH buffer component of the product offset production of sulfuric acid that is created due to persulfate activation (e.g., common persulfate applications exhibit pH <4). During the November 2019 sampling event (3 months post-injection), the ORPs in both wells are negative with transition back to a reducing environment starting to occur. Sulfate concentrations have started to decrease approximately 1 year after injection, further indicating that the environment is transitioning back to more reducing conditions that favor biological attenuation of the targeted compounds.

Table 1. Field and Geochemical Data for MW-6R

MW-6R									
Sampling Date	**08/2019 (Baseline)**	**09/19**	**10/19**	**11/19**	**01/20**	**02/20**	**03/20**	**05/20**	**8/20**
pH	7.28	-	-	5.92	-	6.35	-	7.03	7.01
ORP (mV)	-139	+354	+234	-15.8	-21.1	-44	-70	-62	-70
Persulfate (mg/L)	0	70	-	42	21	7	14	0	0
Sulfate (mg/L)	ND	-	-	ND	-	1,890	-	980	ND*
Iron (mg/L)	7.8	-	-	21	-	34.2	-	18.4	21.7

Minimum detection limit of 109 mg/L

Table 2. Field and Geochemical Data for MW-9

MW-9									
Sampling Date	**08/2019 (Baseline)**	**09/19**	**10/19**	**11/19**	**01/20**	**02/20**	**03/20**	**05/20**	**8/20**
pH	7.21	-	-	6.49	-	6.75	-	7.09	7.05
ORP (mV)	-102	+32.6	+23.4	-48.4	-47.8	-134	-77	-68	-207
Persulfate (mg/L)	0	0	-	0	0	0	0	0	0
Sulfate (mg/L)	ND	-	-	1,170	-	302	-	307	148
Iron (mg/L)	8.6	-	-	38.3	-	24.0	-	7.88	11.0

Following the Provect-OX® application, petroleum hydrocarbon groundwater concentrations have significantly decreased (**Table 3** and **Table 4**). MW-6R exhibited >97% reduction concentrations for all target VOCs other than ethylbenzene (>63% decrease). The VOC reductions in MW-9 were >78% and LNAPL has been eliminated. Additional contaminant concentration decreases in MW-6R and MW-9 are anticipated due to the iron and sulfate enhanced bioremediation processes.

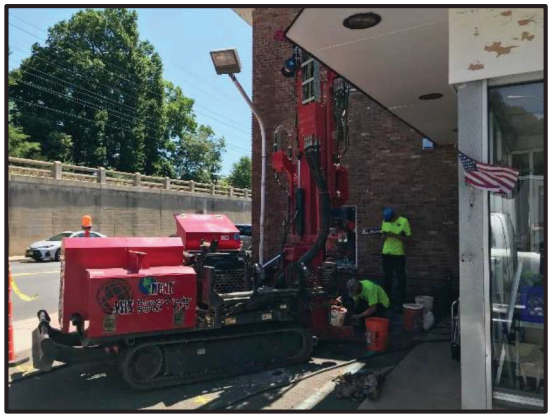
Table 3. VOC Data for MW-6R

MW-6R						
Sampling Date	**08/2019 (Baseline)**	**11/19**	**02/20**	**05/20**	**08/20**	**Reductions**
Benzene (µg/L)	0.129	0.732	0.698	0.560	ND	**100%**
Ethylbenzene (µg/L)	2,510	279	489	1,270	906	**63.9%**
Total Xylenes (µg/L)	5,910	388	123	103	33	**99.4%**
Toluene (µg/L)	1,790	140	6	15	45	**97.5%**
1,2,4-Trimethylbenzene (µg/L)	5,460	22	162	430	134	**97.5%**

ND: Non-Detect

Table 4. VOC Data for MW-9

MW-9						
Sampling Date	**08/2019 (Baseline)**	**11/19**	**02/20**	**05/20**	**08/20**	**Reductions**
Benzene (µg/L)	29.7	14.2	9.7	10.3	6.5	**78.3%**
Ethylbenzene (µg/L)	1,590	1,200	331	1,140	279	**82.5%**
Total Xylenes (µg/L)	6,280	4,070	1,130	1,610	360	**94.3%**
Toluene (µg/L)	7,680	3,690	628	198	52.6	**99.3%**
1,2,4-Trimethylbenzene (µg/L)	5,670	3,870	600	2,520	882	**84.4%**



Please contact our office at (815) 650-2230 or via email at info@provectusenv.com for additional information regarding this project or our technologies.

Provect-OX2™ – *In Situ* Chemical Oxidation + Enhanced Bioremediation for Contaminant Mass Destruction

Former Gasoline Station – Point Pleasant Beach, New Jersey
Constituents of Interest – BTEX, Trimethylbenzenes, and TICs

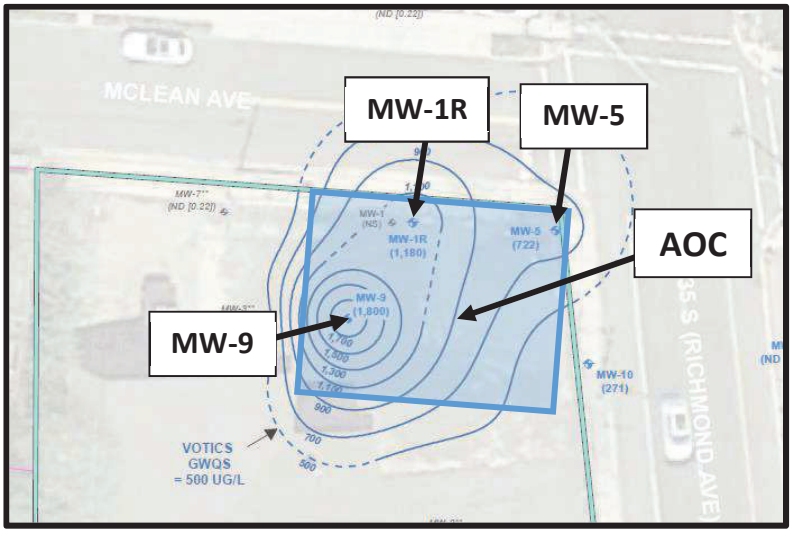
Project Summary

A former gas station located in Point Pleasant Beach, New Jersey was impacted with petroleum hydrocarbons due to leaks from underground storage tanks. The primary contaminants of interest (COIs) at the site were benzene, toluene, ethylbenzene, xylene (BTEX), trimethylbenzenes, and tentatively identified compounds (TICs) The area of concern (AOC) was approx. 2,600 sq ft with a target vertical interval from 7 to 11 feet below ground surface (ft bgs). The geology at the site is primarily a fine to medium grained sand with groundwater being encountered from 7 to 9 ft bgs. Provect-OX2™ was applied *in situ* to address the residual sorbed and dissolved phase petroleum hydrocarbon contaminant mass. Three primary monitoring wells were impacted within this AOC, including MW-1R, MW-5, and MW-9.

Remediation Plan

The remedial scope of work was developed by MidAtlantic Engineering Partners, LLC. and Provectus Environmental Products, Inc. (Provectus), which included the application of 7,550 lbs of Provect-OX2™ to the targeted AOC (**Figure 1**). Provect-OX2™ is a dual-functioning reagent blend that combines *in situ* chemical oxidation (ISCO) plus enhanced bioremediation (US Patent 9,126,245; patents pending). Provect-OX2™ rapidly oxidizes the organic contaminants present in soil and groundwater and provides long-term, sustained secondary bioremediation to manage residuals and prevent contaminant rebound. This is accomplished by using ferric iron (Fe III) as a safe and effective means of activating sodium and potassium persulfates, which quickly yields sulfate radicals ($SO_4^{\bullet-}$) for chemical oxidation treatment. A pH buffer is also preblended with the Provect-OX2™ to offset any post-injection acidic pH conditions that are normally observed with traditional persulfate applications. The technology enhances subsequent utilization of sulfate and iron as terminal electron acceptors for facultative redox reactions to support secondary biodegradation of any residual contaminant mass.

Figure 1: Site Map



The initial implementation plan included slurry injection of Provect-OX2™ at 12 temporary direct push points spaced on 15 ft. centers. Due to elevated injection pressures and heaving sands, a revised implementation plan was developed in the field after the first injection point was completed. The revised plan included the emplacement of Provect-OX2™ into augured boreholes. To ensure a sufficient radius of influence was achieved, a total of 13 boreholes were added to the remediation plan, yielding a total of 25 application locations in a grid-like pattern. The Provect-OX2™ application was implemented between July 22nd and July 27th, 2020. **Figure 2** depicts the treatment AOC.

Figure 2: Area of Concern

Treatment Program Results

Post-application analytical data for the three target monitoring wells are presented below in **Table 1**, **Table 2**, and **Table 3**. MW-1R and MW-9 show the greatest contaminant reductions, with nearly all individual constituents being reduced by more than 95% and all COIs below New Jersey Groundwater Quality Standards (NJ GWQS). Additionally, the geochemistry data for the three target wells exhibit elevated ORPs 12 months after the Provect-OX2™ application including >+100 mV at MW-1R and MW-9. The included pH buffer component of the product offset production of sulfuric acid that is created due to persulfate activation (e.g., common persulfate applications exhibit pH <4). Field data for the monitoring wells are presented below in **Table 4**, **Table 5**, and **Table 6**. Changes in these field parameters are positive indicators of a successful field application and sufficient Provect-OX2™ distribution within the targeted area.

Table 1. VOC Data for MW-1R

MW-1R							
Sample Date	**02/18**	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**	**Reductions**
Benzene (1 µg/L)	8	ND	ND	ND	ND	ND	**100%**
Toluene (600 µg/L)	ND	60	17.1	10.1	ND	ND	**100%**
Ethylbenzene (700 µg/L)	386	780	374	328	170	6.1	**99.2%**
Total Xylenes (1,000 µg/L)	1,529	3,700	562	1,051	520	5.7	**99.8%**
1,2,4-TMB (100 µg/L)	720	1,100	ND	525	140	4.5	**99.6%**
TICs (500 µg/L)	1,180	2,500	1,686	3,690	540	3.4	**99.9%**

ND: Non-Detect ; Shaded indicates compound detected above NJDEP GWQC (standards in parentheses).

Table 2. VOC Data for MW-5

MW-5							
Sample Date	**02/18**	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**	**Reductions**
Benzene (1 µg/L)	ND	ND	ND	0.6	ND	ND	**100%**
Toluene (600 µg/L)	577	160	ND	511	440	210	**-31.3%**
Ethylbenzene (700 µg/L)	400	150	ND	454	400	210	**-40.0%**
Total Xylenes (1,000 µg/L)	1,521	660	ND	1,128	670	300	**54.5%**
1,2,4-TMB (100 µg/L)	300	330	ND	75.9	49.0	8.3	**97.5%**
TICs (500 µg/L)	722	640	ND	3,159	1,200	450	**29.7%**

ND: Non-Detect ; Shaded indicates compound detected above NJDEP GWQC (standards in parentheses).

Table 3. VOC Data for MW-9

MW-9							
SampleDate	**02/18**	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**	**Reductions**
Benzene (1 µg/L)	ND	ND	ND	ND	ND	ND	**-**
Toluene (600 µg/L)	8.2	30	1.1	4.6	37	ND	**100%**
Ethylbenzene (700 µg/L)	123	660	26	243	190	27	**95.9%**
Total Xylenes (1,000 µg/L)	451	3,100	40	971	600	ND	**100%**
1,2,4-TMB (100 µg/L)	329	1,100	ND	479	180	ND	**100%**
TICs (500 µg/L)	1,800	2,200	317	2,825	750	460	**79.1%**

ND: Non-Detect ; Shaded indicates compound detected above NJDEP GWQC (standards in parentheses).

Table 4. Field Data for MW-1R

MW-1R					
Sample Date	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**
pH	6.4	5.1	5.5	5.6	6.3
ORP (mV)	-45	+19	+5	+88	+118

Table 5. Field Data for MW-5

MW-5					
Sample Date	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**
pH	6.3	5.4	5.1	5.9	5.91
ORP (mV)	-25	+84	+308	+210	+157

Table 6. Field Data for MW-9

MW-9					
Sample Date	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**
pH	6.3	5.4	5.1	5.9	5.9
ORP (mV)	-3	+90	+143	+79	+61

The targeted contaminants have reached the NJ GWQS within 1 year after the Provect-OX2™ application. We anticipate reductions will continue as the geochemistry remains ideal with ORPs still increasing due to continued potassium persulfate release. Furthermore, the secondary iron and sulfate enhanced bioremediation processes will remain active in the subsurface for several years after the ISCO reactions are complete.

Please contact our office at (815) 650-2230 or via email at info@provectusenv.com for additional information regarding this project or our technologies.

EZVI-CH4™ – Emulsified Zero Valent Iron (EZVI) with Antimethanogenic Reagents for Chlorinated Dissolved Plume Remediation

Active Dry Cleaner – Green Brook, New Jersey
Contaminants of Interest – Tetrachloroethylene (PCE)

Project Summary

This site is an active dry cleaner located in Green Brook, NJ that was impacted with tetrachloroethylene (PCE) due to former operations and the use of cleaning solvents. Soil impacts were delineated and remediated with excavation and therefore, no further action was required in the vadose zone. Groundwater impacts existed from 10 to 25 feet below ground surface (ft bgs) throughout an approximate 15,000 sq ft area. Soil consisted of clayey sands to 5 ft bgs followed by weathered shale and bedrock at 10 ft bgs. Groundwater fluctuated between 9 and 11 ft bgs with aerobic conditions existing including ORPs >+200 and high dissolved oxygen. The property was active with multiple businesses in operation, although the remediation footprint was located in the parking lot.

Remediation Plan

The *in situ* remediation plan was developed by Provectus Environmental Products, Inc. (Provectus) and Engineering & Land Planning, Inc. (E&LP), which included the application of emulsified zero valent iron and antimethanogenic reagents (EZVI-CH4™) via permanent injection wells. EZVI-CH4™ combines food grade vegetable oil with a surfactant, ZVI, and water in a unique physical structure to remediate chlorinated volatile organic compounds (CVOCs) using both abiotic and biotic processes. EZVI-CH4™ is manufactured to create a water-in-oil emulsion with water drops dispersed within a vegetable oil. During the manufacturing process, steps are taken to ensure that the highly reactive ZVI powder is contained within the aqueous component of the emulsion (i.e., within the water drops). This liquid membrane protects the ZVI from being in direct contact with the groundwater. Only contaminants with a hydrophobic physical chemistry (e.g., CVOCs) will pass through the membrane and react with the ZVI.

Based on the site-specific conditions, a total of 750 gallons of EZVI-CH4™ were applied via the injection wells to remediate the area of concern. Each well was installed with stainless steel casings through the overburden and weathered rock with open holes from 15 to 25 ft bgs. Single packers were used to isolate the desired injection depths in the bedrock. The application was completed by Innovative Environmental Technologies (IET) over two active field days. The site remained active with businesses open during the injection program.

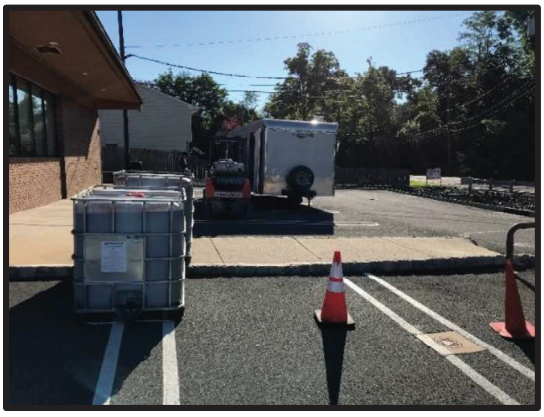


Figure 1: EZVI Totes and Treatment Area

Treatment Program Results

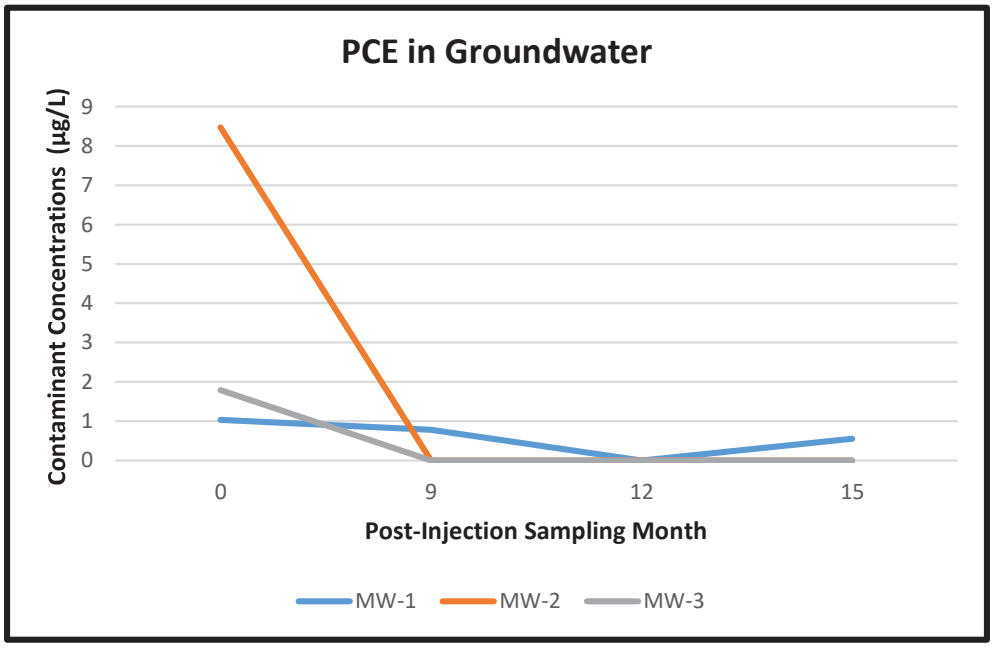
Prior to remediation, the site conditions were strongly aerobic, indicated by elevated ORP and dissolved oxygen levels. Six months post-injection, ORP levels in the target monitoring wells were an average of -135 mV, showing strong indications of EZVI-CH4™ influence. PCE concentrations in the three target wells were reduced below the New Jersey Department of Environmental Protection Ground Water Quality Standards (NJDEP GWQS) of 1 ug/L after the first CVOC analytical sample event, which was conducted nine months post-injection. PCE concentrations in the three target wells have remained below the NJDEP GWQS during subsequent sampling events. Table 1 and Figure 2 below outline the CVOC analytical data over time. Furthermore, no daughter products (e.g., dichloroethene and vinyl chloride) were detected following the EZVI application. Due to the successful *in situ* remedial program and post-injection analytical data, the site has reached closure within the desired time frame.

Table 1: PCE Concentrations in Groundwater

PCE in Groundwater (µg/L)				
	Baseline	**9 Month**	**12 Months**	**15 Months**
MW-1	1.03	0.78	ND	0.55
MW-2	8.47	ND	ND	ND
MW-3	1.79	ND	ND	ND

ND: Non-detect

Figure 2: PCE Concentrations in Groundwater



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Provect-OX2™ – *In Situ* Chemical Oxidation + Enhanced Bioremediation for Contaminant Mass Destruction

Former Gasoline Station – Point Pleasant Beach, New Jersey
Constituents of Interest – BTEX, Trimethylbenzenes, and TICs

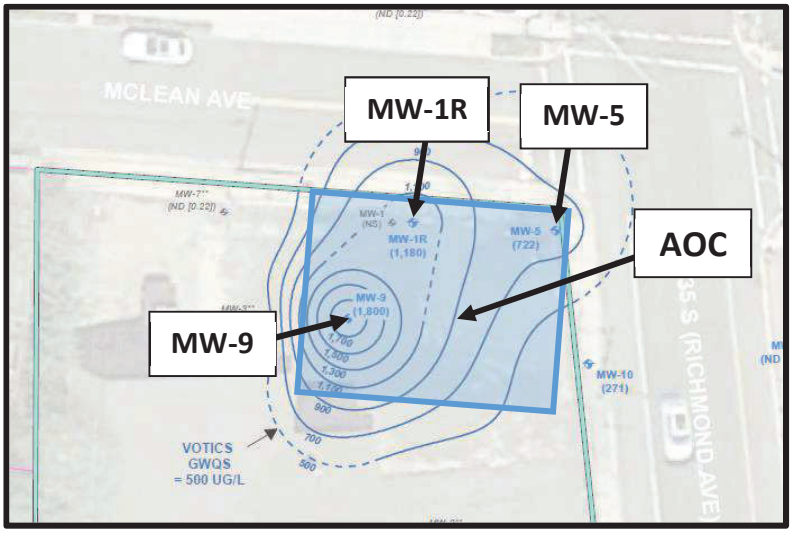
Project Summary

A former gas station located in Point Pleasant Beach, New Jersey was impacted with petroleum hydrocarbons due to leaks from underground storage tanks. The primary contaminants of interest (COIs) at the site were benzene, toluene, ethylbenzene, xylene (BTEX), trimethylbenzenes, and tentatively identified compounds (TICs) The area of concern (AOC) was approx. 2,600 sq ft with a target vertical interval from 7 to 11 feet below ground surface (ft bgs). The geology at the site is primarily a fine to medium grained sand with groundwater being encountered from 7 to 9 ft bgs. Provect-OX2™ was applied *in situ* to address the residual sorbed and dissolved phase petroleum hydrocarbon contaminant mass. Three primary monitoring wells were impacted within this AOC, including MW-1R, MW-5, and MW-9.

Remediation Plan

The remedial scope of work was developed by MidAtlantic Engineering Partners, LLC. and Provectus Environmental Products, Inc. (Provectus), which included the application of 7,550 lbs of Provect-OX2™ to the targeted AOC (**Figure 1**). Provect-OX2™ is a dual-functioning reagent blend that combines *in situ* chemical oxidation (ISCO) plus enhanced bioremediation (US Patent 9,126,245; patents pending). Provect-OX2™ rapidly oxidizes the organic contaminants present in soil and groundwater and provides long-term, sustained secondary bioremediation to manage residuals and prevent contaminant rebound. This is accomplished by using ferric iron (Fe III) as a safe and effective means of activating sodium and potassium persulfates, which quickly yields sulfate radicals ($SO_4^{\bullet-}$) for chemical oxidation treatment. A pH buffer is also preblended with the Provect-OX2™ to offset any post-injection acidic pH conditions that are normally observed with traditional persulfate applications. The technology enhances subsequent utilization of sulfate and iron as terminal electron acceptors for facultative redox reactions to support secondary biodegradation of any residual contaminant mass.

Figure 1: Site Map



The initial implementation plan included slurry injection of Provect-OX2™ at 12 temporary direct push points spaced on 15 ft. centers. Due to elevated injection pressures and heaving sands, a revised implementation plan was developed in the field after the first injection point was completed. The revised plan included the emplacement of Provect-OX2™ into augured boreholes. To ensure a sufficient radius of influence was achieved, a total of 13 boreholes were added to the remediation plan, yielding a total of 25 application locations in a grid-like pattern. The Provect-OX2™ application was implemented between July 22nd and July 27th, 2020. **Figure 2** depicts the treatment AOC.

Figure 2: Area of Concern

Treatment Program Results

Post-application analytical data for the three target monitoring wells are presented below in **Table 1**, **Table 2**, and **Table 3**. MW-1R and MW-9 show the greatest contaminant reductions, with nearly all individual constituents being reduced by more than 95% and all COIs below New Jersey Groundwater Quality Standards (NJ GWQS). Additionally, the geochemistry data for the three target wells exhibit elevated ORPs 12 months after the Provect-OX2™ application including >+100 mV at MW-1R and MW-9. The included pH buffer component of the product offset production of sulfuric acid that is created due to persulfate activation (e.g., common persulfate applications exhibit pH <4). Field data for the monitoring wells are presented below in **Table 4**, **Table 5**, and **Table 6**. Changes in these field parameters are positive indicators of a successful field application and sufficient Provect-OX2™ distribution within the targeted area.

Table 1. VOC Data for MW-1R

MW-1R							
Sample Date	**02/18**	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**	**Reductions**
Benzene (1 µg/L)	8	ND	ND	ND	ND	ND	**100%**
Toluene (600 µg/L)	ND	60	17.1	10.1	ND	ND	**100%**
Ethylbenzene (700 µg/L)	386	780	374	328	170	6.1	**99.2%**
Total Xylenes (1,000 µg/L)	1,529	3,700	562	1,051	520	5.7	**99.8%**
1,2,4-TMB (100 µg/L)	720	1,100	ND	525	140	4.5	**99.6%**
TICs (500 µg/L)	1,180	2,500	1,686	3,690	540	3.4	**99.9%**

ND: Non-Detect ; Shaded indicates compound detected above NJDEP GWQC (standards in parentheses).

Table 2. VOC Data for MW-5

MW-5							
Sample Date	**02/18**	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**	**Reductions**
Benzene (1 µg/L)	ND	ND	ND	0.6	ND	ND	**100%**
Toluene (600 µg/L)	577	160	ND	511	440	210	**-31.3%**
Ethylbenzene (700 µg/L)	400	150	ND	454	400	210	**-40.0%**
Total Xylenes (1,000 µg/L)	1,521	660	ND	1,128	670	300	**54.5%**
1,2,4-TMB (100 µg/L)	300	330	ND	75.9	49.0	8.3	**97.5%**
TICs (500 µg/L)	722	640	ND	3,159	1,200	450	**29.7%**

ND: Non-Detect ; Shaded indicates compound detected above NJDEP GWQC (standards in parentheses).

Table 3. VOC Data for MW-9

MW-9							
SampleDate	**02/18**	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**	**Reductions**
Benzene (1 µg/L)	ND	ND	ND	ND	ND	ND	**-**
Toluene (600 µg/L)	8.2	30	1.1	4.6	37	ND	**100%**
Ethylbenzene (700 µg/L)	123	660	26	243	190	27	**95.9%**
Total Xylenes (1,000 µg/L)	451	3,100	40	971	600	ND	**100%**
1,2,4-TMB (100 µg/L)	329	1,100	ND	479	180	ND	**100%**
TICs (500 µg/L)	1,800	2,200	317	2,825	750	460	**79.1%**

ND: Non-Detect ; Shaded indicates compound detected above NJDEP GWQC (standards in parentheses).

Table 4. Field Data for MW-1R

MW-1R					
Sample Date	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**
pH	6.4	5.1	5.5	5.6	6.3
ORP (mV)	-45	+19	+5	+88	+118

Table 5. Field Data for MW-5

MW-5					
Sample Date	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**
pH	6.3	5.4	5.1	5.9	5.91
ORP (mV)	-25	+84	+308	+210	+157

Table 6. Field Data for MW-9

MW-9					
Sample Date	**02/2020 (Baseline)**	**10/20**	**01/21**	**04/21**	**07/21**
pH	6.3	5.4	5.1	5.9	5.9
ORP (mV)	-3	+90	+143	+79	+61

The targeted contaminants have reached the NJ GWQS within 1 year after the Provect-OX2™ application. We anticipate reductions will continue as the geochemistry remains ideal with ORPs still increasing due to continued potassium persulfate release. Furthermore, the secondary iron and sulfate enhanced bioremediation processes will remain active in the subsurface for several years after the ISCO reactions are complete.

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Provect-OX™ - Self-Activating *In Situ* Chemical Oxidation (ISCO) and Enhanced Bioremediation for Dissolved Plume Destruction

Former Gasoline Station – St. Albans, West Virginia
Constituents of Interest: BTEX, MTBE and TBA
Lead Contractor: Innovative Environmental Technologies, Inc. (IET)

Project Summary

The site is a former gas station located in St. Albans, West Virginia. The site was contaminated with benzene, toluene, ethylbenzene, xylene (BTEX), methyl tert-butyl ether (MTBE), and tert-butyl alcohol (TBA). The area of concern was approximately 3,775 sq ft with a target vertical interval from ca. 6 to 12 feet below ground surface (ft bgs). The geology at the site is primarily clay with depth to groundwater at ca. 5 ft bgs. Two monitoring wells were addressed during the injection program, MW-5R and MW-9. The in situ injection program targeted the BTEX, MTBE and TBA with Provect-OX™ (US Patent 9,126,245), which is an advanced chemical oxidation and accelerated bioremediation technology.

Remediation Plan

Innovative Environmental Technologies, Inc. (IET) applied Provect-OX to the subsurface via a patented injection process and apparatus (US Patent 7,044,152) such that the activation processes occur in a controlled manner. A total of 19 injection points and 7,300 lbs of Provect-OX were utilized to treat the area of concern (**Figure 1**).

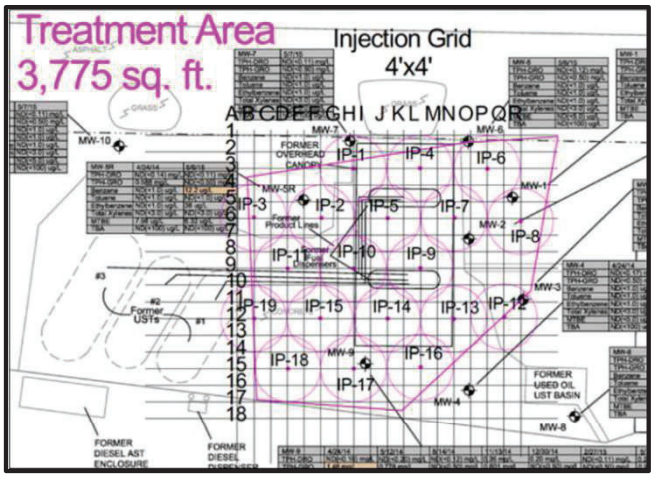

Figure 1: Injection Point Site Map

The Provect-OX rapidly oxidizes the organic contaminants present in soil and groundwater and provides long-term, sustained secondary bioremediation to manage residuals and prevent contaminant rebound. This is accomplished by using ferric iron (Fe III) as a safe and effective means of activating persulfate, which quickly yields sulfate and ferrate radicals for chemical oxidation treatment. The process also enhances subsequent utilization of sulfate and iron as terminal electron acceptors for facultative redox reactions to support secondary biodegradation of any residual contaminant mass.

Treatment Program Results

Field, geochemical and volatile organic compound data for the two target monitoring wells are presented below in **Table 1** and **Table 2**. Chemical oxidative conditions are evident during the first MW-5R post-treatment sampling event with an ORP of +171.7 mV and increases in dissolved oxygen and conductivity. Sulfate and iron measurements confirmed that Provect-OX was

successfully applied with the targeted area. During the June 2016 sampling event, the field parameters transition towards a reducing environment with ORP of -124.5 mV and the dissolved oxygen concentration decreasing to 0.40 mg/L. However, the presence of elevated sulfate and iron concentrations suggest that the environment is still transitioning, and it has not yet established conditions that would fully favor biological attenuation of the targeted compounds.

Due to the absence of any MW-9 field parameter data during the March 2016 sampling event, it is not possible to assess how the geochemistry was initially affected by the remedial injection; however, the highly elevated sulfate and iron concentrations confirm that Provect-OX was successfully applied with the targeted area. During the June 2016 sampling event, the field parameters indicate a reducing environment with an ORP value of -147.6 mV and significantly reduced sulfate and iron concentrations.

Table 1. Field and Geochemical Data for MW-5R and MW-9

	MW-5R			MW-9		
Sampling Date	**05/06/15**	**3/31/16**	**06/21/16**	**05/06/15**	**3/31/16**	**06/21/16**
Depth to Groundwater (ft)	6.26	5.68	6.05	11.33	7.14	5.54
pH	6.48	8.97	8.96	6.28	NM	9.47
ORP (mV)	NM	+171.7	-124.5	NM	NM	-147.6
D.O. (mg/L)	0.16	1.23	0.40	0.21	NM	6.04
Conductivity (mS/cm)	0.804	3.53	2.59	0.657	NM	1,974
Temperature (°C)	16.12	13.93	18.75	17.07	NM	19.04
Sulfate (mg/L)	NM	1,260	1,230	NM	2,000	600
Iron (mg/L)	NM	1.12	8.23	NM	174	0.425

NM: Not Measured

Due to the oxidative and bioattenuation conditions, the petroleum hydrocarbon groundwater concentrations in both monitoring wells decreased, with MW-9 exhibiting non-detect concentrations for all contaminants of concern (**Table 2**). Additional BTEX and MTBE decreases in MW-5R are expected due to the iron and sulfate enhanced bioremediation processes.

Table 2. VOC Data for MW-5R and MW-9

	MW-5R		MW-9	
Sampling Date	**05/07/2015**	**06/24/2016**	**05/07/2015**	**06/24/2016**
Benzene (µg/L)	12.2	7.48	77.0	ND
Toluene (µg/L)	ND	ND	2.89	ND
Ethylbenzene (µg/L)	36.0	25.3	66.5	ND
Total Xylenes (µg/L)	ND	ND	6.64	ND
MTBE (µg/L)	6.32	5.98	72.8	ND
Tert-Butyl Alcohol (µg/L)	ND	ND	1,480	ND

ND: Non-Detect

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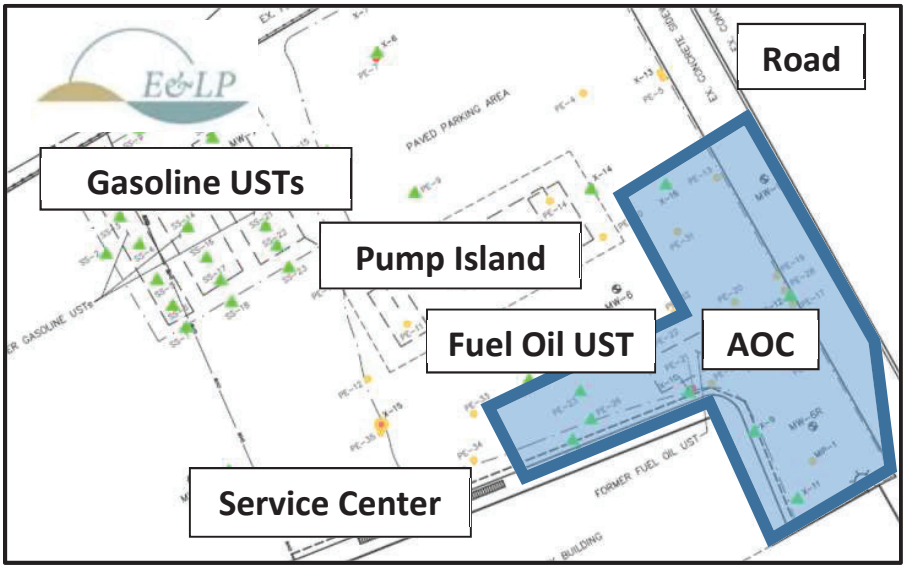
Provect-OX® - *In Situ* Chemical Oxidation + Enhanced Bioremediation for Source Area Remediation

Former Gasoline Station: Madison, New Jersey
Contaminants of Interest: LNAPL, BTEX, and TMB

Project Summary

At a former gas station in Madison, New Jersey, *in situ* remediation was applied to address petroleum hydrocarbon source mass within the subsurface smear and saturated zones. Excavation of gasoline and fuel oil underground tanks (USTs) along with the associated piping and shallow hydrocarbon soil impacts had previously been completed. However, excavation was impacted due to accessibility limitations from the service center building and road. Following excavation and enhanced fluid recovery activities, residual benzene, toluene, ethylbenzene, xylene (BTEX), trimethylbenzene (TMB), and light non-aqueous phase liquid (LNAPL) impacts remained. The primary area of concern (AOC; **Figure 1**) was approximately 1,500 sq ft with a 15-ft vertical target interval from approximately 25 to 40 feet below ground surface (bgs). The geology at the site is dense silt and clay with depth to groundwater at 30 ft bgs**.** The *in situ* injection program targeted the BTEX, TMB, and LNAPL with Provect-OX® (US Patent 9,126,245), which is a catalyzed chemical oxidation process that leverages enhanced bioremediation post-oxidation.

Figure 1: Site Map



Remediation Plan

The remedial program was developed by Engineering & Land Planning Associates, Inc. (E&LP) and Provectus Environmental Products, Inc. (Provectus) with *in situ* implementation provided by Innovative Environmental Technologies, Inc. (IET). A total of 13,300 lbs of Provect-OX® were applied via 20 temporary direct push injection locations to treat the AOC and two impacted monitoring wells. The service center remained open and active during drilling and injection activities.

Provect-OX® rapidly oxidizes the organic contaminants present in soil and groundwater and provides long-term, sustained secondary bioremediation to manage residuals and prevent contaminant rebound. This is accomplished by using ferric iron (Fe III) as a safe and effective means of activating persulfate, which quickly yields sulfate and ferrate (site-specific) radicals for chemical oxidation treatment. A pH buffer is also preblended with the Provect-OX® to offset any post-injection acidic pH conditions that are normally observed with traditional persulfate applications. The technology process enhances subsequent utilization of sulfate and iron as terminal electron acceptors for facultative redox reactions to support secondary biodegradation of any residual contaminant mass.

Treatment Program Results

Field and geochemical data for the two target monitoring wells are presented below in **Table 1** and **Table 2**. Volatile organic compound (VOC) data for the monitoring wells are presented in **Table 3** and **Table 4**. Chemical oxidative conditions are evident during the first MW-6R and MW-9 post-treatment sampling event with increased ORPs of +354 mV and +32.6, respectively. The presence of persulfate, sulfate, and iron in groundwater confirmed that Provect-OX® was successfully distributed within the targeted area. The included pH buffer component of the product offset production of sulfuric acid that is created due to persulfate activation (e.g., common persulfate applications exhibit pH <4). During the November 2019 sampling event (3 months post-injection), the ORPs in both wells are negative with transition back to a reducing environment starting to occur.

Table 1. Field and Geochemical Data for MW-6R

MW-6R										
Sampling Date	**08/2019 (Baseline)**	**09/19**	**10/19**	**11/19**	**01/20**	**02/20**	**03/20**	**05/20**	**08/20**	**09/21**
pH	7.28	-	-	5.92	-	6.35	-	7.03	7.01	6.42
ORP (mV)	-139	+354	+234	-15.8	-21.1	-44	-70	-62	-70	-101
Persulfate (mg/L)	0	70	-	42	21	7	14	0	0	0
Sulfate (mg/L)	ND	-	-	ND	-	1,890	-	980	ND*	720
Iron (mg/L)	7.8	-	-	21	-	34.2	-	18.4	21.7	23.4

Minimum detection limit of 109 mg/L

Table 2. Field and Geochemical Data for MW-9

MW-9										
Sampling Date	**08/2019 (Baseline)**	**09/19**	**10/19**	**11/19**	**01/20**	**02/20**	**03/20**	**05/20**	**08/20**	**09/21**
pH	7.21	-	-	6.49	-	6.75	-	7.09	7.05	6.34
ORP (mV)	-102	+32.6	+23.4	-48.4	-47.8	-134	-77	-68	-207	-87
Persulfate (mg/L)	0	0	-	0	0	0	0	0	0	0
Sulfate (mg/L)	ND	-	-	1,170	-	302	-	307	148	1,230
Iron (mg/L)	8.6	-	-	38.3	-	24.0	-	7.88	11.0	24.2

Following the Provect-OX® application, petroleum hydrocarbon groundwater concentrations have significantly decreased (**Table 3** and **Table 4**). MW-6R exhibited >89% reduction concentrations for all target VOCs other than ethylbenzene (>68% decrease). The VOC reductions in MW-9 were >88% and LNAPL has been eliminated. Additional contaminant concentration decreases in MW-6R and MW-9 are anticipated due to the iron and sulfate enhanced bioremediation processes.

Table 3. VOC Data for MW-6R

MW-6R							
Sampling Date	**08/2019 (Baseline)**	**11/19**	**02/20**	**05/20**	**08/20**	**09/21**	**Reductions**
Benzene (µg/L)	0.129	0.732	0.698	0.560	ND	0.129	**-**
Ethylbenzene (µg/L)	2,510	279	489	1,270	906	784	**68.8%**
Total Xylenes (µg/L)	5,910	388	123	103	33	621	**89.5%**
Toluene (µg/L)	1,790	140	6	15	45	2.5	**99.9%**
1,2,4-Trimethylbenzene (µg/L)	5,460	22	162	430	134	56.6	**99.0%**

ND: Non-Detect

Table 4. VOC Data for MW-9

MW-9							
Sampling Date	**08/2019 (Baseline)**	**11/19**	**02/20**	**05/20**	**08/20**	**9/21**	**Reductions**
Benzene (µg/L)	29.7	14.2	9.7	10.3	6.5	3.56	**88.0%**
Ethylbenzene (µg/L)	1,590	1,200	331	1,140	279	115	**92.8%**
Total Xylenes (µg/L)	6,280	4,070	1,130	1,610	360	84.2	**98.7%**
Toluene (µg/L)	7,680	3,690	628	198	52.6	53.3	**99.3%**
1,2,4-Trimethylbenzene (µg/L)	5,670	3,870	600	2,520	882	357	**93.7%**

Please contact our office at (815) 650-2230 or via email at info@provectusenv.com for additional information regarding this project or our technologies.

Provect-IR® – *In Situ* Chemical Reduction (ISCR) Reagents for Source and Dissolved Plume Remediation

Former Dry Cleaner – Ocean City, New Jersey
Contaminants of Interest – Tetrachloroethylene (PCE), Trichloroethylene (TCE), cis-1,2-Dichloroethene (cis-1,2 DCE), and Vinyl Chloride (VC)

Project Summary

A former print shop and dry cleaner located in a residential Ocean City, New Jersey neighborhood was contaminated due to previously conducted business related activities. Soil and groundwater were impacted with tetrachloroethylene (PCE), trichloroethylene (TCE), cis-1,2-dichloroethene (cis-1,2 DCE), and vinyl chloride (VC). Limited soil excavation was conducted inside the former dry cleaner, but elevated chlorinated volatile organic compound (CVOC) concentrations continued to persist in groundwater. The subsurface geology consisted of coarse sand to a depth of 5 feet below ground surface (ft bgs) followed by a peat layer to a depth of 8 ft bgs. Groundwater is tidally influence with an average depth of 4 ft bgs. Reducing groundwater geochemical conditions were present at the site likely due to anoxic conditions formed within the peat layer. Additional source excavation coupled with soil mixing utilizing an *in situ* chemical reduction (ISCR) amendment, specifically Provect-IR®, was selected to complete source removal and ensure residual contaminant mass was addressed.

Provect-IR® is a site-specific blend of unique reagents combined into a single product that optimizes the *in situ* reductive dechlorination of chlorinated VOC contamination in both soil and groundwater. This technology works by promoting synergistic interactions between zero valent iron (ZVI), hydrophilic, nutrient rich organic carbon sources, chemical oxygen scavengers, vitamins, and mineral sources. This patented combination of natural and food grade amendments promotes ISCR conditions for rapid and effective destruction of the targeted contaminants. Additionally, Provect-IR® is the only ISCR reagent to simultaneously inhibit the production of methane during the requisite carbon fermentation process, which promotes more efficient use of the hydrogen donor while avoiding negative drawbacks associated with elevated methane.

Figure 1: Provect-IR® Applied to Excavation

Remediation Plan

The soil mixing remedial program was designed by Provectus Environmental Products, Inc. (Provectus) in collaboration with Enfuse Environmental, LLC (ENFUSE). Following excavation of the shallow soil impacts, a total of 6,000 lbs of Provect-IR® was applied to the base of the approximate 700 sq ft excavated area with soil mixing conducted to ensure contact with the impacted groundwater. Injection laterals were placed within the backfill material zone as a contingency to apply additional liquid reagents if remedial goals were not achieved. The excavation and Provect-IR® soil mixing remedial program targeted three primary wells, MW-2, MW-4, and MW-8. All monitoring wells remained in-place during excavation and soil mixing activities. Backfill of the excavated area and general site restoration occurred following source removal and blending activities.

Treatment Program Results

The geochemical data from the three performance wells indicate expected results and confirm successful soil blending and reagent distribution of Provect-IR® within the treatment area. Reducing conditions were rapidly observed, with reductions in DO and ORP one-month post-application. After 4 months, ORP continued to decrease and indicated strongly reducing conditions.

Table 1: ORP Data

ORP (mV)				
	Baseline	**1 Month**	**2 Months**	**4 Months**
MW-2	NA	-160	-66	-202
MW-4	NA	-106	-44	-172
MW-8	NA	-121	-52	-153

The monitoring wells with the highest VOC concentrations, MW-2 and MW-8, saw significant contaminant reductions, with each constituent being reduced by at least 90% at five months post-application. Parent compounds PCE and TCE at MW-2 have decreased by 99% and 97%, respectively, while MW-8 did not have parent compounds present. Daughter product reductions at both wells range between 90% to 94% for MW-2 and greater than 99% for MW-8. Contaminant reductions at MW-4 were also significant with each individual constituent being reduced by at least 74%.

Table 3: MW-2 CVOC Data (ug/L)

MW-2						
Sampling Timeframe	**Baseline**	**1 Month**	**2 Months**	**4 Months**	**5 Months**	**Reductions**
cis-1,2-DCE	1,800	230	340	300	100	**94.4%**
PCE	920	22	550	82	6.1	**99.3%**
TCE	450	28	200	82	11	**97.6%**
VC	360	220	160	58	36	**90.0%**

Figure 2: MW-2 CVOC Data

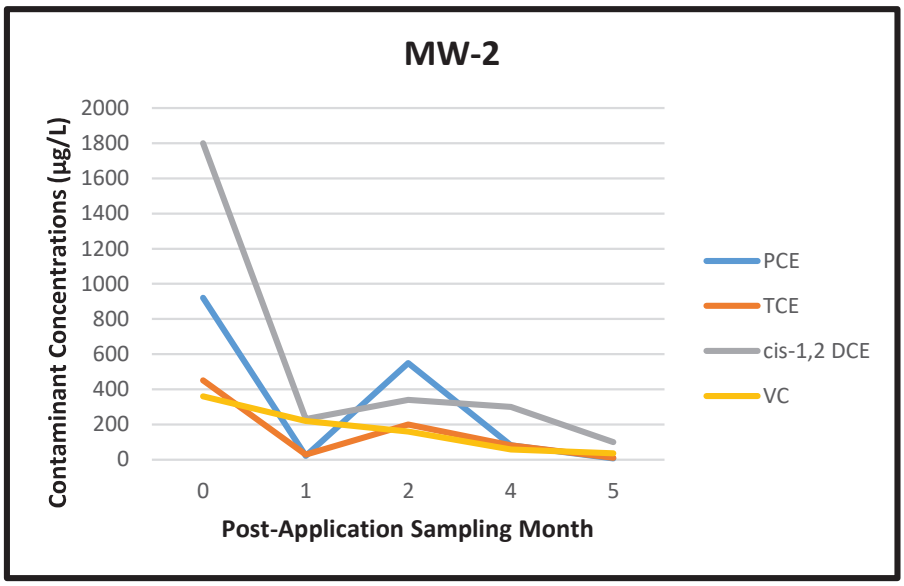
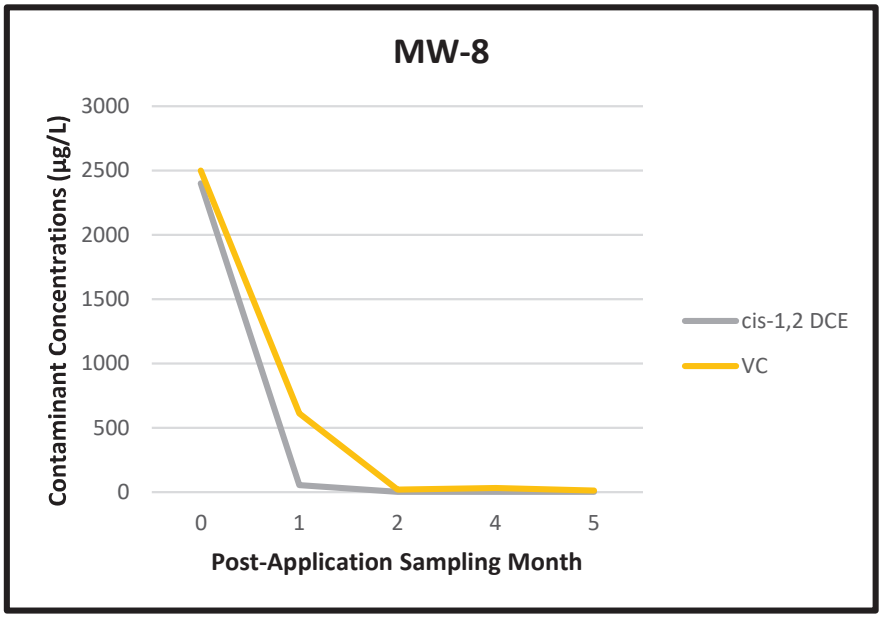


Table 4: MW-8 CVOC Data (ug/L)

MW-8						
Sampling Timeframe	**Baseline**	**1 Month**	**2 Months**	**4 Months**	**5 Months**	**Reductions**
cis-1,2-DCE	2,400	54	1.9	1.4	0.55	**100.0%**
PCE	ND	ND	ND	ND	ND	-
TCE	ND	ND	ND	ND	ND	-
VC	2,500	610	20	32	11	**99.6%**

Figure 3: MW-8 CVOC Data



Lastly, small increases in ethene and ethane were observed in all three target wells, which would be anticipated and is a positive indication of remedial activity in the subsurface. No significant increases in methane were observed, which is due to the antimethanogenic reagents that are included with this site-specific Provect-IR® blend. Based on the current site geochemical conditions, it is expected that the concentrations in the monitoring wells will continue to decrease over future sampling events.

Figure 4: Soil Mixing and Injection Laterals

Please contact our office at (815) 650-2230 or via email at info@provectusenv.com for additional information regarding this project or our technologies.

Appendix B - Site-Specific Health & Safety Plan

HEALTH AND SAFETY PLAN

IDAHO POLE COMPANY SITE
BOZEMAN, MONTANA 59715

Prepared for:

Idaho Pole Company

Prepared by:

Hydrometrics, Inc.
5602 Hesper Rd.
Billings, MT 59106

Updated May 2022

PROJECT CONTACTS

Hydrometrics, Inc.

Health & Safety Coordinator	Jeremy Harwood	(406) 443-4150 ext. 184 (406) 579-0678 mobile
Project Manager/Site Safety Officer	Heidi Kaiser	(406) 656-1172 ext. 306 (406) 697-0410 mobile
Emergency Contact	Greg Lorenson	(406) 443-4150 ext. 142 (406) 465-0941 mobile

Idaho Pole Company

Emergency Contact	Les Lonning	(253) 927-0489 (253) 878-4647 mobile

Amendments or modifications to this plan may be written on a separate page and attached to this plan. Any amendments or modifications must be reviewed and approved by the personnel named above.

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HEALTH AND SAFETY PLAN

IDAHO POLE COMPANY SITE
BOZEMAN, MONTANA 59715

1.0 INTRODUCTION

Hydrometrics, Inc. will be conducting routine groundwater monitoring along with other various tasks at the Idaho Pole Company (IPC) Site located near the intersection of Cedar and L Street in Bozeman, Montana as shown on Figure 1. Other tasks may include building and well decommissioning, drilling, well installation and soil sample collection.

Prior to conducting any field activities on the subject site, ensure that all principal responsible parties and oversight are aware of the field activities that are being performed under an approved work plan.

The provisions set forth in this plan apply to the employees of Hydrometrics and its subcontractors working to conduct the following tasks: site decommissioning, drilling, well construction, excavation, sampling and in situ injections.

This site safety plan will address the expected potential safety concerns and hazards that may be encountered during work on site for this project. If small changes in site or working conditions occur as activities progress, Hydrometrics will address these changes with an appropriate job safety analysis (JSA).

1.1 AUTHORITY FOR SITE SAFETY AND ORIENTATION

The Project Manager/Site Safety Officer (PM/SSO) is responsible for project safety and for implementing the provisions of this plan. The Health and Safety Coordinator (H&SC) is

responsible for the overall Hydrometrics' Health and Safety Program. The PM/SSO and H&SC have the authority to audit site activities for compliance with the provisions of this plan. They may suspend or modify work practices or dismiss subcontractors whose conduct does not meet the requirements specified in this plan.

The PM/SSO is responsible for communicating the information contained in this plan to Hydrometrics' personnel assigned to this project and to the responsible representative of each subcontractor working for Hydrometrics on this project. The PM/SSO is the senior Hydrometrics' employee on site and is responsible for addressing the following items:

- Implementing the site safety plan, company policies, and procedures;
- Requiring and maintaining adequate safety supplies and equipment inventory on site;
- Conducting daily safety and orientation meetings and advising workers regarding hazards;
- Implementing site control, decontamination and contamination reduction procedures;
- Reporting accidents or incidents; and
- Conducting inspections to determine the effectiveness of the site safety plan and to report any deficiencies to the corporate Health and Safety Coordinator for correction.

All personnel working on site have the authority to suspend work any time they find that the provisions of the plan are inadequate for worker safety. The PM/SSO will promptly inform the H&SC of deficiencies within the plan or individuals or subcontractors whose conduct is not consistent with the requirements of this plan. Hydrometrics' field personnel and subcontractors will attend safety and orientation meetings for safety issues and will review the project tasks before beginning work. The meeting will be led by the PM/SSO and be based off the Hydrometrics' Tailgate Health & Safety Review form as listed in Appendix A.

2.0 GENERAL PROJECT SAFETY OVERVIEW

The major safety concerns expected to be encountered on during site activities physical hazards associated with using or being around drilling equipment and power tools and exposure to water and soil contaminated with Site chemicals of concern (COCs). Task-specific Job Safety Analysis (JSA) (included in Appendix A of this site safety plan), will be used to address the risks and safety measures associated with drilling, sampling, and monitoring well installation. Additional JSAs, depending on the task(s), may list additional Personal Protective Equipment (PPE) not shown here in the general site safety plan.

The major chemical hazard concerns expected to be encountered on this project are pentachlorophenol, fuel-related hydrocarbon compounds and dioxins/furans in groundwater and soil. Potential levels of exposure are not anticipated to reach the Permissible Exposure Limit (PEL) or threshold limit values (TLV). Additionally, the reagents used for in situ injections planned for 2022 are strong oxidizers requiring special handing (refer to SDS in Appendix B). Dermal contact and inhalation are the most prevalent exposure pathways.

Hearing conservation program adherence is mandatory to be in compliance with this site safety plan. The anticipated level and duration of noise exposure and which hearing protective devices will be worn are discussed during the safety and orientation meeting.

3.0 POTENTIAL DAILY PROJECT SAFETY HAZARDS

Anticipated hazards associated with project activities include:

- Slips, trips and falls;
- Pinch points;
- Traffic;
- Maneuvering and backing vehicles or equipment into potentially limited space;
- Overhead obstructions when raising or lowering the drill rig or power probe mast;
- Use of heavy and powered equipment included but not limited to
    - Drilling rig or power probe set up and operation,
    - Decontamination with potential exposure to heating elements and hot water; and
- Hand tools having the potential for cuts or crushing impact.
- Hot or cold working environments, creating potential for heat exhaustion, sunburn or frostbite.
- Exposure to chemical oxidizers during reagent mixing for in-situ injections.
- Local traffic on Cedar Street and Bohart Lane.

The PM/SSO will be responsible for taking steps to protect employees from preventable physical and/or environmental hazards. Daily traffic concerns are addressed in section 6.0.

4.0 PERSONAL PROTECTIVE EQUIPMENT (PPE) REQUIREMENTS

Field personnel, subcontractors, are required to wear the following **Level D** protective clothing and equipment (PPE) at a minimum while conducting work at the job site:

- Safety glasses meeting ANSI standard ANSI Z87.1-2003;
- Safety-Toe footwear, meeting ANSI standard Z41.1-1967;
- Hearing protection (as dictated in Section 6.0);
- Hard hat meeting ANSI standard Z89.1-1997 or later; and
- Hand protection (gloves) appropriate to individual tasks.

Hard hats are required only for drilling and decommissioning activities at the site and are not necessary for groundwater monitoring.

Face shields and waterproof clothing may be required for handling chemical oxidizers used for in situ injections.

5.0 HEARING CONSERVATION PROGRAM

This section summarizes the Hydrometrics Hearing Conservation Program. Hydrometrics' employees and subcontractors must have hearing protection available on site for working conditions that can result in hearing damage. Due to the changing working environment, engineering controls are typically not applicable to mitigate noise in the field environment; therefore, hearing protection such as plugs, canal blocks, or muffs are employed. Subcontractors must provide PPE as required in this site safety plan for their employees. Hydrometrics will attempt to verify worker training but does not assume the responsibility of the employer in any way. Hydrometrics' Hearing Conservation Program includes the following basic topics:

- Applicable OSHA regulation 1910.95;
- Audiometric testing program (initial and annual testing thereafter);
- Training on the use of hearing conservation devices and their limitations;
- Nature of noise hazards to be encountered in the work environment; and
- Length of time at which noise exposure can result in hearing damage.

Anytime during work when the decibel (dB) noise level exceeds 85 over a time weight average of eight hours requires the Hearing Conservation Program and use of hearing protection, either muffs and/or plugs. If the noise reduction level is protective of hearing (less than 90 dB for an 8-hour work day), move forward with the work. In the event that the noise reduction does not provide adequate hearing protection, contact your manager and do not proceed with the work.

For subcontractors using heavy equipment, it is their responsibility to provide the dBA noise level measurements for their equipment.

6.0 EMERGENCY RESPONSE PROCEDURES

In the event of a fire, explosion, or property damage, Hydrometrics will be immediately notified. If necessary, local fire or response agencies will be called. A cellular telephone, or where possible, a land line telephone such as a pay phone shall be used when calling the local fire or response agency. Once notifications to the local fire or response agency are made (if necessary), contact your PM/SSO, H&SC, or any project manager or officer of the company. Provide details of the event to management. Management then notifies the client of the incident.

In the event of a small, contained fire, 9-1-1 will be contacted, and properly trained Hydrometrics personnel may attempt to extinguish the fire provided personnel are not in danger of being trapped and will use the fire extinguishers on hand. If the fire cannot be extinguished, the procedures in the preceding paragraph should be followed.

In the event of an accident resulting in physical injury, first aid will be administered, and the injured worker will be transported to the nearest hospital or emergency medical clinic for emergency treatment. Minor band aid type injuries will be treated using first aid kit materials and be reported to the PM/SSO. A physician's attention is required for all other injuries. Subcontractors may already have arrangements with a different occupational medical clinic or urgent care facility. Hydrometrics shall allow an injured subcontractor employee to be taken to a location authorized by their company and allow the subcontractor to implement their case management policies and procedures. If an injured person requires treatment beyond first aid, call 9-1-1 and request an ambulance.

6.1 EMERGENCY TELEPHONE NUMBERS

Fire Police or Ambulance **9-1-1**

Local Police Number ..... **(406) 657-8200**

Local Fire Department Number ..... **(406) 582-2350**

Bozeman Health Deaconess Hospital ..... **(406) 414-5000**

Emergency Care/After Hours Medical Services

Bozeman Health Deaconess Hospital

915 Highland Blvd

Bozeman, Montana 59715

6.2 DRIVING DIRECTION TO BOZEMAN HEALTH DEACONESS HOSPITAL EMERGENCY ROOM

Proceed south on L Street (turns to N. Wallace at railroad crossing) until you reach Main Street, taka left and proceed to Highland Boulevard to the Hospital. The route is shown on Figure 2.

6.3 ADDITIONAL CONTACT PHONE NUMBERS

Local Public Utility Service Providers

Electric Utility Number ..... Northwestern Energy (888)-467-2669

Sewer/Water Number ..... City of Bozeman (406)-582-3203

Gas Company ..... Montana-Dakota Utilities (800) 638-3278

Additional Contingency Telephone Numbers

Hydrometrics, Inc. Local Office, Billings, MT ..... 406) 656-1172

Hydrometrics, Inc. Corporate Office, Helena, Montana ..... (406) 443-4150

We, the undersigned, agree that all activities conducted during and for completion of this project will be performed in accordance with the site-specific health and safety plan and with the following common safety objectives.

1) The first and foremost priority during this project is to maintain a safe and healthy work environment.
2) No work will be performed until every necessary safety precaution has been taken.
3) No project objectives will knowingly be allowed to put at risk human health and the environment.

We, the undersigned, have also confirmed that a site-specific health and safety plan and the appropriate Safety Data Sheets have been provided, reviewed, and understood.

If at any time during the performance of activities on this project there is an unsafe condition, then we will immediately take action to alleviate the unsafe condition. If we are unable to cause the cessation of the unsafe condition, then we will immediately contact the PM/SSO.

The undersigned have read and understood the Health and Safety Plan and agree to abide by its contents.		
Printed Name	**Signature**	**Date**

FIGURES

FIGURE 1. SITE OVERVIEW MAP

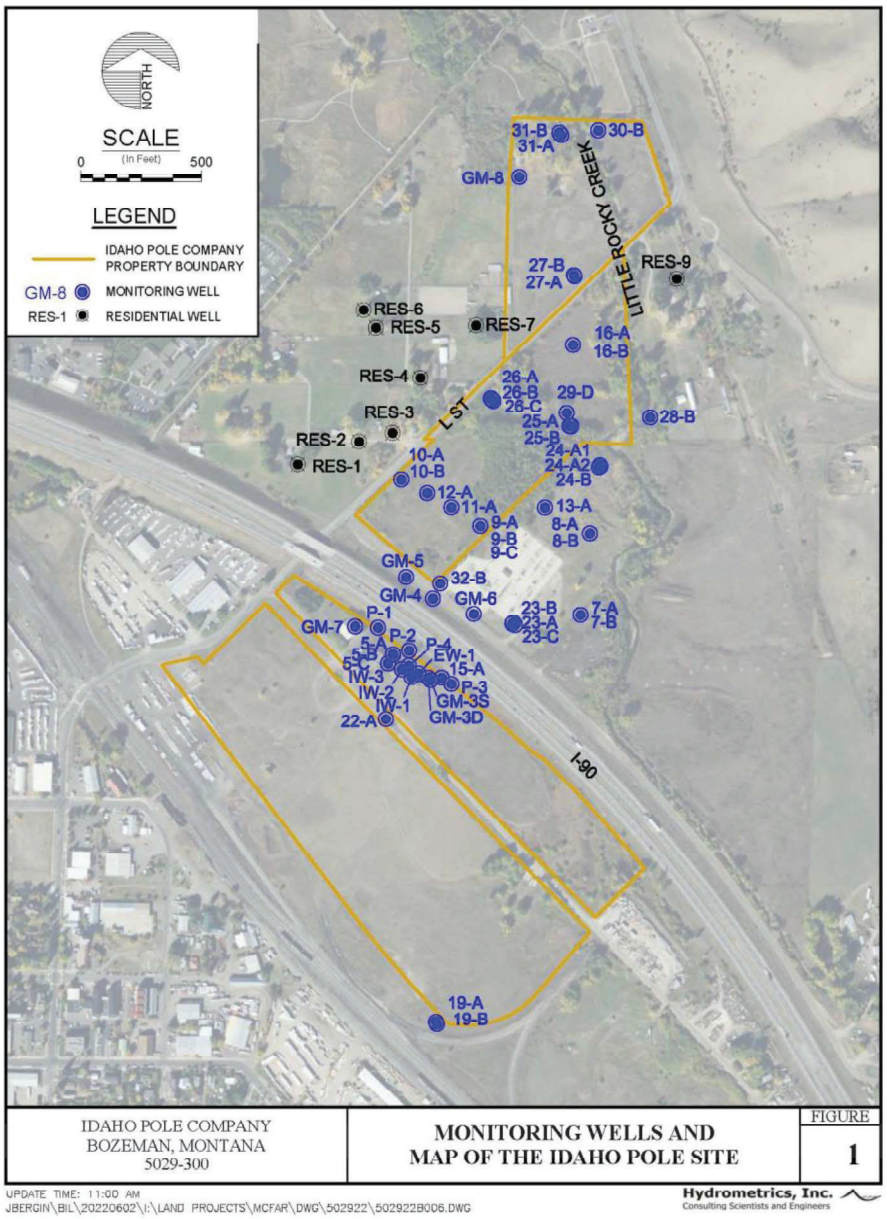
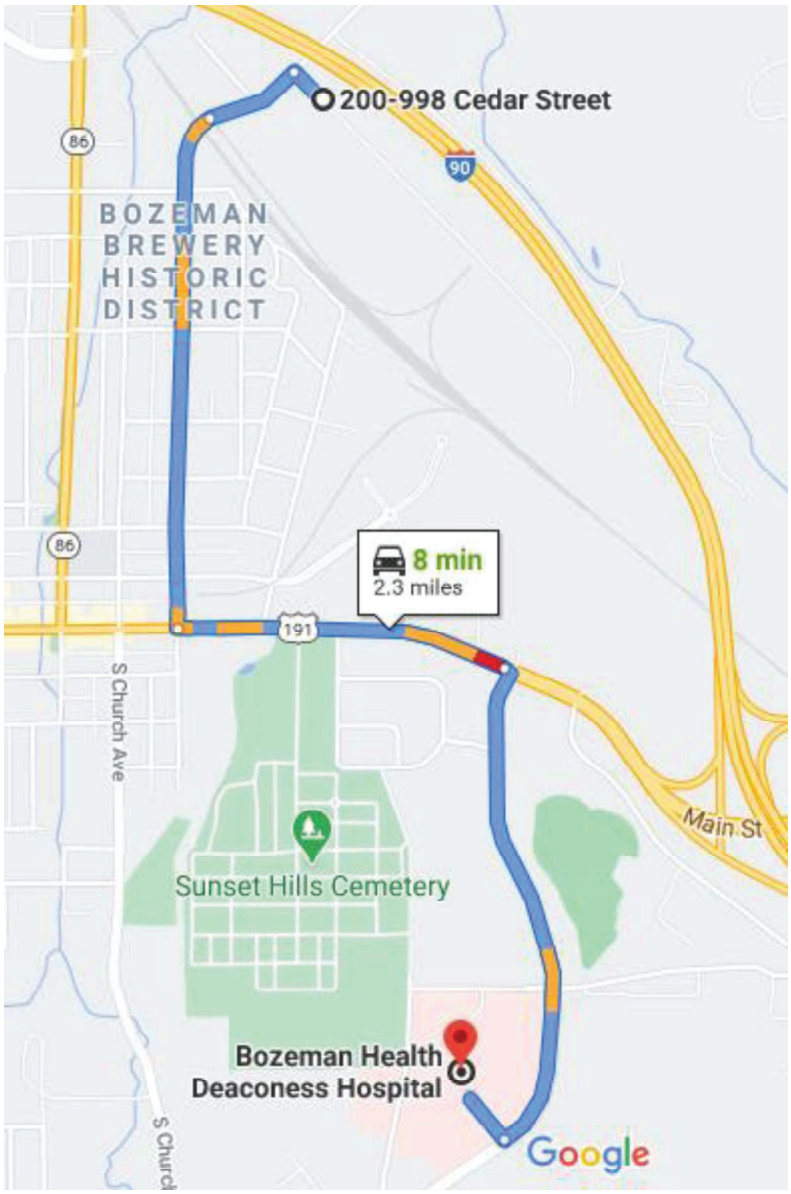


FIGURE 2. HOSPITAL ROUTE MAP



APPENDIX A

HEALTH & SAFETY FORMS AND CHECKLISTS

Tailgate Health & Safety Review

Hydrometrics' Power Probe JSA

Hydrometrics Inc. Power Probe Safety Checklist

Hydrometrics Drilling Rig Safety Checklist

TAILGATE HEALTH & SAFETY REVIEW

Location: _____**Idaho Pole Site Bozeman MT**_____ _

Project(s): _____

Issues discussed: _____

☐ Site Health & Safety Plan

☐ Proposed tasks discussed

☐ JSA's completed and reviewed for proposed activities

☐ PPE

___ Hardhats

___ Safety Glasses with side shields

___ Work gloves or latex/nitrile gloves as appropriate

___ Steel toed boots

___ Hearing Protection (if sound levels exceed 85 dba)

___ Respirators (not req. unless indicated by monitoring - i.e. PID readings of breathing space exceed 100 ppm)

Other:_____

☐ Marking off work areas with cones, barricades or tape

☐ Fire extinguisher and first aid kit accessible to work area

☐ Weather hazards - Heat, Cold, Wind, Lightning

Other:

Reviewed by: _____

_____

_____

_____

Hydrometrics' Power Probe JSA

COMPANY/ PROJECT NAME or ID/ LOCATION (City, State)	DATE		
Hydrometrics, Inc./ Helena / Montana	2/17/06	☐ NEW ☒ REVISED	PAGE 1 of 1

WORK ACTIVITY (Description):
gs are advanced using Hydrometrics' AMS PowerProbe rig. A four-foot sampling core is driven using the PowerProbe hydraulic drive/push and hammer. Samples are obtained using a with threaded outer casing (4 feet by 2 inch O.D.) and threaded hollow inner drive rods (4 feet by 0.75 inch O.D.) attached to a clear four foot polyethylene sampler or Macroliner within he sample is retained within the Macroliner (4 feet by 1.0625 inch) to retain a continuous soil sample core. The Macroliners are cut lengthwise and soils for analysis are collected and/or brings may be facilitated by advancement the auger to relieve soil overburden pressures (see below). Decon is to be performed between each boring location. Underground utilities must rked prior to job start.

Well installation may be accomplished using PowerProbe hydraulic drive hollow stem augers (5 feet by 6 inch O.D.). Augers are advanced using the PowerProbe hydraulic drive and motor. Auger flights are added every 5 feet as drilling progresses. Upon reaching the desired depth the center cutter is removed from entire length of boring. If placing a well in loose soil well completion is accomplished by removing auger flights in stepwise fashion to prevent hole collapse adding the filter pack sand and Bentonite seal after each step interval. Otherwise wells may be completed "open hole" removing all but the drive auger flight after placement of well casing.

Additional Requirements: Avoid placement of rig atop dry vegetation to avoid ignition. Only one person should be designated to operate the probe controls. An established distance from overhead utilities should be maintained. Inspect entire rig system and vehicle for serviceability. Immediately correct discrepancies, failure to comply may lead to loss of life, injury, and/or damage to equipment. Ensure all team personnel have read and are familiar with the site Heath and Safety Plan if one is provided.

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Alex Bargmeyer	Engineer I/Engineer	Mike Wignot	President
Larry Johnson	Scientist/Geologist	Bob Anderson	Principal/Health & Safety Officer

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT (SEE CRITICAL ACTIONS FOR TASK-SPECIFIC REQUIREMENTS)

☐ REFLECTIVE VEST	☒ GOGGLES (HIGH WINDS)	☐ AIR PURIFYING RESPIRATOR	☒ GLOVES
☒ HARD HAT	☐ FACE SHIELD		☒ OTHER
☐ LIFELINE / HARNESS	☒ HEARING PROTECTION	☐ SUPPLIED RESPIRATOR	DUST MASK (OPTIONAL)
☒ SAFETY GLASSES	☒ SAFETY SHOES	☐ PPE CLOTHING	

[1]JOB STEPS	[2]POTENTIAL HAZARDS	[3]CRITICAL ACTIONS TO MITIGATE HAZARDS
1. Placing rig in position to drill	Crush from shifting of rig, backing into obstacles or personnel	Ensure the vehicle emergency brake is set, wheels are chocked and vehicle is level. Use spotter for backing up.
2. Preparation of rig for direct push or drilling	Crush and pinch hazards from rig movement, tools and debris in mechanism, overhead hazard	Ensure all personnel are clear from pinch and crush hazards. Perform inspection of rig mechanisms for tools and debris. Ensure there is no overhead hazard before raising boom.
3. Working around the rig	Slip, trip hazards, noise hazards, flying debris, overhead hazard, crush	Ensure the area is free of debris and use caution, maintain communication with operator. Wearing ear protection, eye protection, hardhat, gloves and steel toe boots are required.

4. Driving rods and augers to depth	Pinch and crush, falling object and lifting hazards	Keep hands clear of the top of the rod and auger. Keep feet clear of the probe foot. Ensure rod-lifting yoke is removed or caged. Use proper lifting techniques and do not lift weight beyond capability. *See Auger Drilling JSA*
5. Extraction of inner rods/cutter and sampler	Pinch, crush, falling object and lifting hazards	Keep the hydraulic system off while changing direct push rods, removing samplers and center cutter rods. Ensure rod-lifting yoke is removed or caged. Use proper lifting techniques and do not lift weight beyond capability.
6. Removing sample from Macroliner	Cut	Wear leather gloves while cutting tubes, use appropriate tools.
7. Extraction of outer casing, auger and handling	Pinch, crush, falling object and lifting hazards	Secure casing with vice grips and/or spanner wrench prior to removing each section. Ensure rod-lifting yoke is removed or caged. Use proper lifting techniques and do not lift weight beyond capability.
8. Abandonment of boreholes or well installations	Debris, dust	Use eye protection when pouring sand and Bentonite. Wear a dust mask if dust is an inhalation hazard. Well installations see *Well Completion JSA*.

HYDROMETRICS, INC. POWER PROBE SAFETY CHECKLIST

INSPECTION	INITIAL	FOLLOW-UP
Inspect drill rig for any damage to body, windows, windshield, mirrors.		
Check tire condition, pressure, lug nuts. Include inside duals.		
Check that headlights, brake lights, and turn signals are all working.		
Check fluids including engine oil, windshield washer fluid.		
Check that windshield wipers and windshield washer is working.		
Check that drill rig mast is fully lowered and secured.		
Check hydraulic fittings and hoses for leaks and damage.		
Check that all materials and equipment on flatbed are properly stowed and secured.		
Check that exterior tool is closed and properly secured.		
Confirm that the following safety equipment is in truck and in proper condition:		
Fire extinguisher (check % full and inspection date)		
First aid kit (check that kit is fully stocked)		
Wheel chocks		
Spill mats		
Traffic controls (signage, cones, etc.)		
Make sure you have the appropriate clothing/fluids for weather conditions.		
If augering, check that lead auger/lead center plug and bit and top center "T" bar and sufficient augers are loaded to complete project.		

If dual tube probing check that liner grabbers, inner caps, pull plugs, drive shoes, top drive adapter, and sufficient macros/liners are in truck.		
Review and check that project work plan, HASP, emergency contact information and other project-specific documents are in truck.		
Review and check that applicable JSAs are in truck: i.e., Power Probe Operation; Safe Driving.		
Confirm that all utilities locates have been completed, including any client-specific protocol.		
AT THE WORK SITE:		
Hold tailgate safety meeting and record in project field book		
Check for overhead powerlines and hazards.		
Complete Hydrometrics Health and Safety Daily Awareness Form; Review HASP and or other project-specific documents; Review emergency contact information.		

Completed by: _____ Date: _____

Signed: _____

Give copy of completed form to Project Manager and Hydrometrics H&S Department

APPENDIX B

SAFETY DATA SHEETS

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/02/2014 Revised on 10/16/2017

* 1 Identification

· **Product identifier**

· **Trade name: Buffered Provect-OX® Self Activating ISCO Enhanced Bioremediation Reagent**
· **Application of the substance / the mixture**
In situ and *ex situ* chemical oxidation of contaminants and compounds of concern for environmental remediation applications.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Provectus Environmental Products
2871 W. Forest Road
Suite 2
Freeport, IL 61032
Phone: 815-650-2230
Fax: 815-650-2232
www.provectusenvironmental.com
· **Emergency telephone number:** (815) 650-2230

2 Hazard(s) identification

· **Classification of the substance or mixture**


Flame over circle

May intensify fire; oxidizer.


Health hazard

May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Harmful if swallowed.
Harmful if inhaled.
Causes skin irritation.
Causes serious eye irritation.
May cause an allergic skin reaction.
May cause respiratory irritation.

· **Label elements**
· **GHS label elements**
The product is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**


GHS03 GHS07 GHS08

(Contd. on page 2)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/02/2014 Revised on 10/16/2017

Trade name: Buffered Provect-OX® Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 1)

· **Signal word** Danger

· **Hazard-determining components of labeling:**
disodium peroxodisulphate; sodium persulfate

· **Hazard statements**
May intensify fire; oxidizer.
Harmful if swallowed or if inhaled.
Causes skin irritation.
Causes serious eye irritation.
May cause allergy or asthma symptoms or breathing difficulties if inhaled.
May cause an allergic skin reaction.
May cause respiratory irritation.

· **Precautionary statements**
Take any precaution to avoid mixing with combustibles.
Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
In case of inadequate ventilation wear respiratory protection.
Keep/Store away from clothing/combustible materials.
Avoid breathing dust/fume/gas/mist/vapors/spray.
Use only outdoors or in a well-ventilated area.
Wear protective gloves/protective clothing/eye protection/face protection.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Contaminated work clothing should not be allowed out of the workplace.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Specific treatment (see on this label).
Take off contaminated clothing and wash before reuse.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
Wash contaminated clothing before reuse.
IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.
If skin irritation occurs: Get medical advice/attention.
If skin irritation or rash occurs: Get medical advice/attention.
If eye irritation persists: Get medical advice/attention.
Rinse mouth.
In case of fire: Use for extinction: CO2, powder or water spray.
IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell.
IF ON SKIN: Wash with plenty of water.
Call a POISON CENTER/doctor if you feel unwell.
If experiencing respiratory symptoms: Call a POISON CENTER/doctor.
Store locked up.
Store in a well-ventilated place. Keep container tightly closed.
Dispose of contents/container in accordance with local/regional/national/international regulations.

· **Classification system:**

· **NFPA ratings (scale 0 - 4)**

Health = 2
Fire = 3
Reactivity = 2

The substance possesses oxidizing properties.

(Contd. on page 3)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/02/2014 Revised on 10/16/2017

Trade name: Buffered Provect-OX® Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 2)

· **HMIS-ratings (scale 0 - 4)**

Health = *2
Fire = 3
Reactivity = 2

3 Composition/information on ingredients

· **Chemical characterization: Mixtures**
· **Description:** Mixture of the substances listed below with nonhazardous additions.

· **Dangerous components:**

7775-27-1	disodium peroxodisulphate; sodium persulfate Ox. Sol. 2, H272; Resp. Sens. 1, H334; Acute Tox. 4, H302; Acute Tox. 4, H332; Skin Irrit. 2, H315; Eye Irrit. 2A, H319; Skin Sens. 1, H317; STOT SE 3, H335	80-99%
1309-37-1	Ferric oxide	1-20%
n.a.	Terr-OR™ buffer and ferrate stabilizer (see associated SDS)	0-4%

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
· **After inhalation:**
Supply fresh air and to be sure call for a doctor.
In case of unconsciousness, place patient securely on side position for transportation.
· **After skin contact:** Immediately wash with water and soap and rinse thoroughly.
· **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.
· **After swallowing:** Immediately call a doctor.
· **Most important symptoms and effects, both acute and delayed** No further relevant information available.
· **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Fire-fighting measures

· **Extinguishing media**
· **Suitable extinguishing agents:**
CO2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** Mouth respiratory protective device.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures** Not required.
· **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:**
Dispose contaminated material as waste according to section 13.
Ensure adequate ventilation.
· **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

(Contd. on page 4)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/02/2014 Revised on 10/16/2017

Trade name: Buffered Provect-OX® Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 3)

7 Handling and storage

· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
Prevent formation of dust.
· **Information about protection against explosions and fires:** Protect from heat.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:** No special requirements.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:**
Keep receptacle tightly sealed.
Protect from heat and direct sunlight.
· **Specific end use(s)** No further relevant information available.

8 Exposure controls/personal protection

· **Additional information about design of technical systems:** No further data; see section 7.

· **Control parameters**

· **Components with occupational exposure limits:**	
7775-27-1 disodium peroxodisulphate	
TLV	Long-term value: 0.1 mg/m³ as Persulfates
1309-37-1 Ferric oxide	
PEL	Long-term value: 10 mg/m³ Fume
REL	Long-term value: 5 mg/m³ Dust & fume, as Fe
TLV	Long-term value: 5* mg/m³ *as respirable fraction

· **Additional information:** The lists that were valid during the creation were used as basis.

· **Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:** Keep away from foodstuffs, beverages and feed. Immediately remove all soiled and contaminated clothing. Wash hands before breaks and at the end of work.
· **Breathing equipment:** Not required.
· **Protection of hands:**

Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Select glove material based on penetration times, rates of diffusion and degradation.

(Contd. on page 5)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/02/2014 Revised on 10/16/2017

Trade name: Buffered Provect-OX® Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 4)

· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material cannot be calculated in advance and has therefore to be checked prior to the application.

· **Penetration time of glove material**
The exact break-through time has to be determined and observed by the manufacturer of the protective gloves.

*
9 Physical and chemical properties

· **Information on basic physical and chemical properties**
· **General Information**
· **Appearance:**

Form:	Powder
Color:	Red
· **Odor:**	Odorless
· **Odor threshold:**	Not determined.
· **pH-value @ 20 °C (68 °F):**	6
· **Change in condition**	
Melting point/Melting range:	Not determined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Contact with combustible material may cause fire.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Auto igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Not determined.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapour density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Soluble.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **Solvent content:**	
Organic solvents:	0.0 %
Solids content:	99.5 %

(Contd. on page 6)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/02/2014 Revised on 10/16/2017

Trade name: Buffered Provect-OX® Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 5)

· **Other information** No further relevant information available.

10 Stability and reactivity

· **Reactivity** No further relevant information available.
· **Chemical stability**
· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Possibility of hazardous reactions** No dangerous reactions known.
· **Conditions to avoid** No further relevant information available.
· **Incompatible materials:** No further relevant information available.
· **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**

· **LD/LC50 values that are relevant for classification:**		
7775-27-1 disodium peroxodisulphate		
Oral	LD50	925 mg/kg (rat)

· **Primary irritant effect:**
· **on the skin:** No irritant effect.
· **on the eye:** No irritating effect.
· **Sensitization:**
Sensitization possible through inhalation.
Sensitization possible through skin contact.
· **Additional toxicological information:**
The product shows the following dangers according to internally approved calculation methods for preparations:
Harmful
Irritant

· **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer)**		
1309-37-1	Ferric oxide	3

· **NTP (National Toxicology Program)**
None of the ingredients is listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

12 Ecological information

· **Toxicity**
· **Aquatic toxicity:** No further relevant information available.
· **Persistence and degradability** No further relevant information available.
· **Bioaccumulative potential** No further relevant information available.
· **Mobility in soil** No further relevant information available.
· **Additional ecological information:**
· **General notes:** Water hazard class 1 (Self-assessment): slightly hazardous for water
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

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Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/02/2014 Revised on 10/16/2017

Trade name: Buffered Provect-OX® Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 6)

· **Other adverse effects** No further relevant information available.

13 Disposal considerations

· **Waste treatment methods**
· **Recommendation:**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.

· **Uncleaned packaging:**
· **Recommendation:** Disposal must be made according to official regulations.
· **Recommended cleansing agent:** Water, if necessary with cleansing agents.

*

14 Transport information

· **UN-Number**	1505
· **UN proper shipping name**	Sodium Persulfate
· **Transport hazard class(es)**	5.1 (Oxidizer)
· **Packing group**	III
· **Environmental hazards:**	
· **Marine pollutant:**	No
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	UN1505, Sodium persulfate

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **Sara**

· **Section 355 (extremely hazardous substances):**
None of the ingredients is listed.

· **Section 313 (Specific toxic chemical listings):**
None of the ingredients is listed.

· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

· **Proposition 65**

· **Chemicals known to cause cancer:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients is listed.

· **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**
None of the ingredients is listed.

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Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

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Trade name: Buffered Provect- OX® Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 7)

· **TLV (Threshold Limit Value established by ACGIH)**		
1309-37-1	Ferric oxide	A4
· **NIOSH-Ca (National Institute for Occupational Safety and Health)**		
None of the ingredients is listed.		

· **GHS label elements**
The product is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**

GHS03 GHS07 GHS08

· **Signal word** Danger

· **Hazard-determining components of labeling:**
disodium peroxodisulphate
· **Hazard statements**
May intensify fire; oxidizer.
Harmful if swallowed or if inhaled.
Causes skin irritation.
Causes serious eye irritation.
May cause allergy or asthma symptoms or breathing difficulties if inhaled.
May cause an allergic skin reaction.
May cause respiratory irritation.
· **Precautionary statements**
Take any precaution to avoid mixing with combustibles.
Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
In case of inadequate ventilation wear respiratory protection.
Keep/Store away from clothing/combustible materials.
Avoid breathing dust/fume/gas/mist/vapors/spray.
Use only outdoors or in a well-ventilated area.
Wear protective gloves/protective clothing/eye protection/face protection.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Contaminated work clothing should not be allowed out of the workplace.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Specific treatment (see on this label).
Take off contaminated clothing and wash before reuse.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
Wash contaminated clothing before reuse.
IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.
If skin irritation occurs: Get medical advice/attention.
If skin irritation or rash occurs: Get medical advice/attention.
If eye irritation persists: Get medical advice/attention.
Rinse mouth.
In case of fire: Use for extinction: CO2, powder or water spray.
IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell.
IF ON SKIN: Wash with plenty of water.
Call a POISON CENTER/doctor if you feel unwell.

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Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

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Trade name: Buffered Provect- OX® Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 8)

If experiencing respiratory symptoms: Call a POISON CENTER/doctor.
Store locked up.
Store in a well-ventilated place. Keep container tightly closed.
Dispose of contents/container in accordance with local/regional/national/international regulations.

· **National regulations:**

The product is subject to be labeled according with the prevailing version of the regulations on hazardous substances.

· **State Right to Know**

7775-27-1	disodium peroxodisulphate Ox. Sol. 2, H272; Resp. Sens. 1, H334; Acute Tox. 4, H302; Acute Tox. 4, H332; Skin Irrit. 2, H315; Eye Irrit. 2A, H319; Skin Sens. 1, H317; STOT SE 3, H335	80-99%
1309-37-1	Ferric oxide	1-20%

All ingredients are listed.

· **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Date of preparation / last revision** 06/02/2014 / 3

· **Abbreviations and acronyms:**
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
Ox. Sol. 2: Oxidising Solids, Hazard Category 2
Acute Tox. 4: Acute toxicity, Hazard Category 4
Skin Irrit. 2: Skin corrosion/irritation, Hazard Category 2
Eye Irrit. 2A: Serious eye damage/eye irritation, Hazard Category 2A
Resp. Sens. 1: Sensitisation - Respirat., Hazard Category 1
Skin Sens. 1: Sensitisation - Skin, Hazard Category 1
STOT SE 3: Specific target organ toxicity - Single exposure, Hazard Category 3

· ***** Data compared to the previous version altered.**

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Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 07/02/2018 Revised on 6/15/2018

* 1 Identification

· **Product identifier**

· **Trade name: Buffered Provect-OX2™ Self Activating ISCO Enhanced Bioremediation Reagent**
· **Application of the substance / the mixture**
In situ and *ex situ* chemical oxidation of contaminants and compounds of concern for environmental remediation applications.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Provectus Environmental Products
2871 W. Forest Road
Suite 2
Freeport, IL 61032
Phone: 815-650-2230
Fax: 815-650-2232
www.provectusenvironmental.com
· **Emergency telephone number:** (815) 650-2230

2 Hazard(s) identification

· **Classification of the substance or mixture**

Flame over circle

May intensify fire; oxidizer.

Health hazard

May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Harmful if swallowed.
Harmful if inhaled.
Causes skin irritation.
Causes serious eye irritation.
May cause an allergic skin reaction.
May cause respiratory irritation.

· **Label elements**
· **GHS label elements**
The product is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**

GHS03 GHS07 GHS08

(Contd. on page 2)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

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Trade name: Buffered Provect-OX2™ Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 1)

· **Signal word** Danger

· **Hazard-determining components of labeling:**
disodium peroxodisulphate; sodium persulfate

· **Hazard statements**
May intensify fire; oxidizer.
Harmful if swallowed or if inhaled.
Causes skin irritation.
Causes serious eye irritation.
May cause allergy or asthma symptoms or breathing difficulties if inhaled.
May cause an allergic skin reaction.
May cause respiratory irritation.

· **Precautionary statements**
Take any precaution to avoid mixing with combustibles.
Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
In case of inadequate ventilation wear respiratory protection.
Keep/Store away from clothing/combustible materials.
Avoid breathing dust/fume/gas/mist/vapors/spray.
Use only outdoors or in a well-ventilated area.
Wear protective gloves/protective clothing/eye protection/face protection.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Contaminated work clothing should not be allowed out of the workplace.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Specific treatment (see on this label).
Take off contaminated clothing and wash before reuse.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
Wash contaminated clothing before reuse.
IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.
If skin irritation occurs: Get medical advice/attention.
If skin irritation or rash occurs: Get medical advice/attention.
If eye irritation persists: Get medical advice/attention.
Rinse mouth.
In case of fire: Use for extinction: CO2, powder or water spray.
IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell.
IF ON SKIN: Wash with plenty of water.
Call a POISON CENTER/doctor if you feel unwell.
If experiencing respiratory symptoms: Call a POISON CENTER/doctor.
Store locked up.
Store in a well-ventilated place. Keep container tightly closed.
Dispose of contents/container in accordance with local/regional/national/international regulations.

· **Classification system:**

· **NFPA ratings (scale 0 - 4)**

Health = 2
Fire = 3
Reactivity = 2

The substance possesses oxidizing properties.

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Safety Data Sheet (SDS)

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Trade name: Buffered Provect-OX2™ Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 2)

· **HMIS-ratings (scale 0 - 4)**

Health = *2
Fire = 3
Reactivity = 2

3 Composition/information on ingredients

· **Chemical characterization: Mixtures**
· **Description:** Mixture of the substances listed below with nonhazardous additions.

· **Dangerous components:**

7727-21-1	Potassium peroxodisulfate; potassium persulfate Ox. Sol. 2, H272; Resp. Sens. 1, H334; Acute Tox. 4, H302; Acute Tox. 4, H332; Skin Irrit. 2, H315; Eye Irrit. 2B, H319; Skin Sens. 1, H317; STOT SE 3, H335	50-70%
7775-27-1	Disodium peroxodisulphate; sodium persulfate Ox. Sol. 2, H272; Resp. Sens. 1, H334; Acute Tox. 4, H302; Acute Tox. 4, H332; Skin Irrit. 2, H315; Eye Irrit. 2B, H319; Skin Sens. 1, H317; STOT SE 3, H335	20-30%
1309-37-1	Ferric oxide	1-20%
n.a.	Terr-OR™ buffer and ferrate stabilizer (see associated SDS)	0-5%

4 First-aid measures

· **Description of first aid measures**
· **General information:**
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
· **After inhalation:**
Supply fresh air and to be sure call for a doctor.
In case of unconsciousness, place patient securely on side position for transportation.
· **After skin contact:** Immediately wash with water and soap and rinse thoroughly.
· **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.
· **After swallowing:** Immediately call a doctor.
· **Most important symptoms and effects, both acute and delayed** No further relevant information available.
· **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Fire-fighting measures

· **Extinguishing media**
· **Suitable extinguishing agents:**
CO2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** Mouth respiratory protective device.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures** Not required.
· **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **Methods and material for containment and cleaning up:**
Dispose contaminated material as waste according to section 13.
Ensure adequate ventilation.
· **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

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Safety Data Sheet (SDS)

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(Contd. of page 3)

7 Handling and storage

· **Precautions for safe handling**
Thorough dedusting.
Ensure good ventilation/exhaustion at the workplace.
Prevent formation of dust.
· **Information about protection against explosions and fires:** Protect from heat.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:** No special requirements.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:**
Keep receptacle tightly sealed.
Protect from heat and direct sunlight.
· **Specific end use(s)** No further relevant information available.

8 Exposure controls/personal protection

· **Additional information about design of technical systems:** No further data; see section 7.

· **Control parameters**

· **Components with occupational exposure limits:**	
7727-21-1 Potassium peroxodisulfate	
TLV	Long-term value: 0.1 mg/m³ as Persulfates
7775-27-1 Disodium peroxodisulphate	
TLV	Long-term value: 0.1 mg/m³ as Persulfates
1309-37-1 Ferric oxide	
PEL	Long-term value: 10 mg/m³ Fume
REL	Long-term value: 5 mg/m³ Dust & fume, as Fe
TLV	Long-term value: 5* mg/m³ *as respirable fraction

· **Additional information:** The lists that were valid during the creation were used as basis.

· **Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:** Keep away from foodstuffs, beverages and feed. Immediately remove all soiled and contaminated clothing. Wash hands before breaks and at the end of work.
· **Breathing equipment:** Not required.
· **Protection of hands:**

Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Select glove material based on penetration times, rates of diffusion and degradation.

(Contd. on page 5)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 07/02/2018 Revised on 6/15/2018

Trade name: Buffered Provect-OX2™ Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 4)

· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material cannot be calculated in advance and has therefore to be checked prior to the application.

· **Penetration time of glove material**
The exact break-through time has to be determined and observed by the manufacturer of the protective gloves.

*
9 Physical and chemical properties

· **Information on basic physical and chemical properties**
· **General Information**
· **Appearance:**

Form:	Powder
Color:	Red
· **Odor:**	Odorless
· **Odor threshold:**	Not determined.
· **pH-value @ 20 °C (68 °F):**	6
· **Change in condition**	
Melting point/Melting range:	Not determined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Contact with combustible material may cause fire.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Auto igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Not determined.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapour density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Soluble.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **Solvent content:**	
Organic solvents:	0.0 %
Solids content:	99.5 %

(Contd. on page 6)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 07/02/2018 Revised on 6/15/2018

Trade name: Buffered Provect-OX2™ Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 5)

· **Other information** No further relevant information available.

10 Stability and reactivity

· **Reactivity** No further relevant information available.
· **Chemical stability**
· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Possibility of hazardous reactions** No dangerous reactions known.
· **Conditions to avoid** No further relevant information available.
· **Incompatible materials:** No further relevant information available.
· **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**

· **LD/LC50 values that are relevant for classification:**		
Oral	LD50	1130 mg/kg (rate)
7775-27-1 disodium peroxodisulphate		
Oral	LD50	925 mg/kg (rat)

· **Primary irritant effect:**
· **on the skin:** No irritant effect.
· **on the eye:** No irritating effect.
· **Sensitization:**
Sensitization possible through inhalation.
Sensitization possible through skin contact.
· **Additional toxicological information:**
The product shows the following dangers according to internally approved calculation methods for preparations:
Harmful
Irritant

· **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer)**		
1309-37-1	Ferric oxide	3

· **NTP (National Toxicology Program)**
None of the ingredients is listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

12 Ecological information

· **Toxicity**
· **Aquatic toxicity:** No further relevant information available.
· **Persistence and degradability** No further relevant information available.
· **Bioaccumulative potential** No further relevant information available.
· **Mobility in soil** No further relevant information available.
· **Additional ecological information:**
· **General notes:** Water hazard class 1 (Self-assessment): slightly hazardous for water
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

(Contd. on page 7)

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Trade name: Buffered Provect-OX2™ Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 6)

· **Other adverse effects** No further relevant information available.

13 Disposal considerations

· **Waste treatment methods**
· **Recommendation:**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.

· **Uncleaned packaging:**
· **Recommendation:** Disposal must be made according to official regulations.
· **Recommended cleansing agent:** Water, if necessary with cleansing agents.

* 14 Transport information

· **UN-Number**	1505 and 1492
· **UN proper shipping name**	Sodium Persulfate and Potassium Persulfate
· **Transport hazard class(es)**	5.1 (Oxidizer)
· **Packing group**	III
· **Environmental hazards:**	
· **Marine pollutant:**	No
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	UN1505, Sodium persulfate and UN1492, Potassium persulfate

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **Sara**

· **Section 355 (extremely hazardous substances):**
None of the ingredients is listed.

· **Section 313 (Specific toxic chemical listings):**
None of the ingredients is listed.

· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

· **Proposition 65**

· **Chemicals known to cause cancer:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients is listed.

· **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**
None of the ingredients is listed.

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(Contd. of page 7)

· **TLV (Threshold Limit Value established by ACGIH)**		
1309-37-1	Ferric oxide	A4
· **NIOSH-Ca (National Institute for Occupational Safety and Health)**		
None of the ingredients is listed.		

· **GHS label elements**
The product is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**

GHS03 GHS07 GHS08

· **Signal word** Danger

· **Hazard-determining components of labeling:**
Potassium peroxodisulfate, disodium peroxodisulphate
· **Hazard statements**
May intensify fire; oxidizer.
Harmful if swallowed or if inhaled.
Causes skin irritation.
Causes serious eye irritation.
May cause allergy or asthma symptoms or breathing difficulties if inhaled.
May cause an allergic skin reaction.
May cause respiratory irritation.
· **Precautionary statements**
Take any precaution to avoid mixing with combustibles.
Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
In case of inadequate ventilation wear respiratory protection.
Keep/Store away from clothing/combustible materials.
Avoid breathing dust/fume/gas/mist/vapors/spray.
Use only outdoors or in a well-ventilated area.
Wear protective gloves/protective clothing/eye protection/face protection.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Contaminated work clothing should not be allowed out of the workplace.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Specific treatment (see on this label).
Take off contaminated clothing and wash before reuse.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
Wash contaminated clothing before reuse.
IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.
If skin irritation occurs: Get medical advice/attention.
If skin irritation or rash occurs: Get medical advice/attention.
If eye irritation persists: Get medical advice/attention.
Rinse mouth.
In case of fire: Use for extinction: CO2, powder or water spray.
IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell.
IF ON SKIN: Wash with plenty of water.
Call a POISON CENTER/doctor if you feel unwell.

(Contd. on page 9)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 07/02/2018 Revised on 6/15/2018

Trade name: Buffered Provect-OX2™ Self Activating ISCO Enhanced Bioremediation Reagent

(Contd. of page 8)

If experiencing respiratory symptoms: Call a POISON CENTER/doctor.
Store locked up.
Store in a well-ventilated place. Keep container tightly closed.
Dispose of contents/container in accordance with local/regional/national/international regulations.

· **National regulations:**

The product is subject to be labeled according with the prevailing version of the regulations on hazardous substances.

· **State Right to Know**

7727-21-1	Potassium peroxodisulfate	50-70%
	Ox. Sol. 2, H272; Resp. Sens. 1, H334; Acute Tox. 4, H302; Acute Tox. 4, H332; Skin Irrit. 2, H315; Eye Irrit. 2B, H319; Skin Sens. 1, H317; STOT SE 3, H335	
7775-27-1	Disodium peroxodisulphate	20-30%
	Ox. Sol. 2, H272; Resp. Sens. 1, H334; Acute Tox. 4, H302; Acute Tox. 4, H332; Skin Irrit. 2, H315; Eye Irrit. 2A, H319; Skin Sens. 1, H317; STOT SE 3, H335	
1309-37-1	Ferric oxide	1-20%
-na-	Terr-OR buffer and ferrate stabilizer (see associated SDS)	0 – 5%

All ingredients are listed.

· **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Date of preparation / last revision** 06/02/2014 / 3

· **Abbreviations and acronyms:**
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
Ox. Sol. 2: Oxidizing Solids, Hazard Category 2
Acute Tox. 4: Acute toxicity, Hazard Category 4
Skin Irrit. 2: Skin corrosion/irritation, Hazard Category 2
Eye Irrit. 2A: Serious eye damage/eye irritation, Hazard Category 2A
Resp. Sens. 1: Sensitization - Respirat., Hazard Category 1
Skin Sens. 1: Sensitization - Skin, Hazard Category 1
STOT SE 3: Specific target organ toxicity - Single exposure, Hazard Category 3

· ***** Data compared to the previous version altered.**

SDS / MSDS Created by MSDS Authoring Services (www.MSDSAuthoring.com)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 01/26/2016 Reviewed on 01/26/2016

* 1 Identification

· **Product identifier**

· **Trade name: Provect-IR ISCR Reagent**
· **Product description**
Remediation product for the treatment of soil, sediment and groundwater. Not for use in potable water sources.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Provectus Environmental Products, Inc.
2871 W. Forest Road - Suite 2
Freeport, IL 61032
Phone: 815-650-2230
Fax: 815-650-2230
www.provectusenvironmental.com
· **Emergency telephone number:** 815-650-2230

* 2 Hazard(s) identification

· **Classification of the substance or mixture**
The product is not classified according to the Globally Harmonized System (GHS).

· **Label elements**
· **GHS label elements** Non-Regulated Material
· **Hazard pictograms** Non-Regulated Material
· **Signal word** Non-Regulated Material
· **Hazard statements** Non-Regulated Material
· **Hazard description:**
CONTAINMENT HAZARD: Any vessel that contains wetted reagent must be vented due to potential pressure build up from fermentation gases.
· **Classification system:**
· **NFPA ratings (scale 0 - 4)**

Health = 0
Fire = 1
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**

Health = 0
Fire = 1
Reactivity = 0

3 Composition/information on ingredients

	Proprietary	40 to 90%
7439-89-6	iron	5 to 90%
4075-81-4	calcium dipropionate	0 to 4%

· **Chemical characterization: Mixtures**
· **Description:** Mixture of the substances listed below with nonhazardous additions.

· **Dangerous components:**

8013-01-2	Yeast extracts	STOT SE 3, H335	0.5 to 5%

(Contd. on page 2)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 01/26/2016 Reviewed on 01/26/2016

Trade name: Provect-IR ISCR Reagent

(Contd. of page 1)

9000-30-0	Guar gum	STOT SE 3, H335; Eye Irritant 2B, H320; Combustible Dust	0 to 5%
7757-83-7	sodium sulfite	Acute Toxicity 4, H302	0 to 2%

4 First-aid measures

· ***Description of first aid measures***
· ***After inhalation:*** Remove person to fresh air. If signs/symptoms continue, get medical attention.
· ***After skin contact:*** Wash off with soap and water. Get medical attention if irritation develops.
· ***After eye contact:*** Flush with water for 5 minutes
· ***After swallowing:***
Rinse mouth with water and afterwards drink plenty of milk or water. Call a poison control center or doctor immediately for treatment advice.
· ***Most important symptoms and effects, both acute and delayed*** No further relevant information available.
· ***Indication of any immediate medical attention and special treatment needed***
No further relevant information available.

5 Fire-fighting measures

· ***Extinguishing media***
· ***Suitable extinguishing agents:***
CO2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· ***Special hazards arising from the substance or mixture*** No further relevant information available.
· ***Advice for firefighters***
· ***Protective equipment:*** No special measures required.

* 6 Accidental release measures

· ***Personal precautions, protective equipment and emergency procedures*** Not required.
· ***Environmental precautions:*** Do not allow to enter sewers/ surface or potable water.
· ***Methods and material for containment and cleaning up:***
Cover powder spill with plastic sheet or tarp to minimize spreading and keep powder dry. Sweep or vacuum up spillage and place in vented container.
· ***Reference to other sections***
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

* 7 Handling and storage

· ***Precautions for safe handling*** No special measures required.
· ***Information about protection against explosions and fires:*** Combustible material

· ***Conditions for safe storage, including any incompatibilities***
· ***Storage:***
· ***Requirements to be met by storerooms and receptacles:***
CONTAINMENT HAZARD: Any vessel that contains wetted reagent must be vented due to potential pressure build up from fermentation gases.
· ***Information about storage in one common storage facility:*** Not required.
· ***Further information about storage conditions:***
Keep tightly closed in a dry and cool place. Keep away from open flames, hot surfaces and sources of ignition. Any material that is wetted must be vented due to potential pressure build up from fermentation gases.

(Contd. on page 3)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 01/26/2016 Reviewed on 01/26/2016

Trade name: Provect-IR ISCR Reagent

(Contd. of page 2)

· **Specific end use(s)** No further relevant information available.

*
8 Exposure controls/personal protection

· **Additional information about design of technical systems:** No further data; see section 7.

· **Control parameters**
· **Components with occupational exposure limits:**
The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.
· **Additional information:**
Dry or powdered ingredients are combustible. Dispersal of finely divided dust from products into air may form mixtures that are ignitable and explosive. Minimize airborne dust generation and eliminate sources of ignition.

· **Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
The usual precautionary measures for handling chemicals should be followed.
· **Breathing equipment:** Not required.
· **Protection of hands:** Not required.
· **Eye protection:** Not required.

*
9 Physical and chemical properties

· **Information on basic physical and chemical properties**
· **General Information**
· **Appearance:**

Form:	Solid
Color:	Brown to Green
· **Odor:**	Pleasant
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Not determined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Not determined.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Auto igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Dry or powdered ingredients are combustible. Dispersal of finely divided dust from products into air may form mixtures that are ignitable and explosive. Minimize airborne dust generation and eliminate sources of ignition.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	Not determined.

(Contd. on page 4)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 01/26/2016 Reviewed on 01/26/2016

Trade name: Provect-IR ISCR Reagent

(Contd. of page 3)

· **Relative density** Not determined.
· **Vapor density** Not applicable.
· **Evaporation rate** Not applicable.

· **Solubility in / Miscibility with**
Water: Soluble.

· **Partition coefficient (n-octanol/water):** Not determined.

· **Viscosity:**
Dynamic: Not applicable.
Kinematic: Not applicable.

· **Solvent content:**
Organic solvents: 0.0 %

Solids content: 100.0 %
· **Other information** No further relevant information available.

10 Stability and reactivity

· **Reactivity** No further relevant information available.
· **Chemical stability** Product is stable under normal conditions.
· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Possibility of hazardous reactions** No dangerous reactions known.
· **Conditions to avoid** No further relevant information available.
· **Incompatible materials:** No further relevant information available.
· **Hazardous decomposition products:** No dangerous decomposition products known.

* 11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** No irritant effect.
· **on the eye:** Product dust may cause eye irritation.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
The product is not subject to classification according to internally approved calculation methods for preparations:
When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us.

· **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer)**
None of the ingredients is listed.
· **NTP (National Toxicology Program)**
None of the ingredients is listed.
· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

12 Ecological information

· **Toxicity**
· **Aquatic toxicity:** No further relevant information available.

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Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 01/26/2016 Reviewed on 01/26/2016

Trade name: Provect-IR ISCR Reagent

(Contd. of page 4)

· ***Persistence and degradability*** No further relevant information available.
· ***Bioaccumulative potential*** No further relevant information available.
· ***Mobility in soil*** No further relevant information available.
· ***Additional ecological information:***
· ***General notes:*** Water hazard class 1 (Self-assessment): slightly hazardous for water
· ***Results of PBT and vPvB assessment***
· ***PBT:*** Not applicable.
· ***vPvB:*** Not applicable.
· ***Other adverse effects*** No further relevant information available.

13 Disposal considerations

· ***Waste treatment methods***
· ***Recommendation:*** Smaller quantities can be disposed of with household waste.

· ***Uncleaned packaging:***
· ***Recommendation:*** Disposal according to official regulations municipal.
· ***Recommended cleansing agent:*** Water, if necessary with cleansing agents.

* 14 Transport information

· ***UN-Number***
· ***DOT, ADR, ADN, IMDG, IATA*** Non-Regulated Material
· ***UN proper shipping name***
· ***DOT, ADR, ADN, IMDG, IATA*** Non-Regulated Material
· ***Transport hazard class(es)***

· ***DOT, ADR, ADN, IMDG, IATA***
· ***Class*** Non-Regulated Material
· ***Packing group***
· ***DOT, ADR, IMDG, IATA*** Non-Regulated Material
· ***Environmental hazards:***
· ***Marine pollutant:*** No
· ***Special precautions for user*** Not applicable.
· ***Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code*** Not applicable.
· ***UN "Model Regulation":*** -

15 Regulatory information

· ***Safety, health and environmental regulations/legislation specific for the substance or mixture***
· ***Sara***

· ***Section 355 (extremely hazardous substances):***

None of the ingredients is listed.

· ***Section 313 (Specific toxic chemical listings):***

None of the ingredients is listed.

· ***TSCA (Toxic Substances Control Act):***

7439-89-6	Iron
4075-81-4	calcium dipropionate
8013-01-2	Yeast extracts
9000-30-0	Guar gum
7757-83-7	sodium sulfite

(Contd. on page 6)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 01/26/2016 Reviewed on 01/26/2016

Trade name: Provect-IR ISCR Reagent

(Contd. of page 5)

· **Proposition 65**

· **Chemicals known to cause cancer:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients is listed.

· **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**
None of the ingredients is listed.

· **TLV (Threshold Limit Value established by ACGIH)**
None of the ingredients is listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.

· **GHS label elements** Non-Regulated Material
· **Hazard pictograms** Non-Regulated Material
· **Signal word** Non-Regulated Material
· **Hazard statements** Non-Regulated Material

· **National regulations:**
The product is subject to be labeled according with the prevailing version of the regulations on hazardous substances.

· **State Right to Know**

	Proprietary	40-90%
7439-89-6	Iron	5-90%
4075-81-4	calcium dipropionate	2-12%
8013-01-2	Yeast extracts STOT SE 3, H335	≤ 2.5%
9000-30-0	Guar gum STOT SE 3, H335; Eye Irrit. 2B, H320; Combustible Dust	≤ 2.5%
7757-83-7	sodium sulfite Acute Tox. 4, H302	≤ 2.5%

All ingredients are listed.

· **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Date of preparation / last revision** 01/23/2016 / 4
· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association

(Contd. on page 7)

Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 01/26/2016 *Reviewed on 01/26/2016*

Trade name: Provect-IR ISCR Reagent

(Contd. of page 6)

ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
Acute Tox. 4: Acute toxicity, Hazard Category 4
Eye Irrit. 2B: Serious eye damage/eye irritation, Hazard Category 2B
STOT SE 3: Specific target organ toxicity - Single exposure, Hazard Category 3

· **** Data compared to the previous version altered.***

Appendix C – Hydrometrics Standard Operating Procedures

HSOP-4

CHAIN-OF-CUSTODY PROCEDURES, PACKING, AND SHIPPING SAMPLES

Prepared by: Mark T Walker **Date:** 6/04

Reviewed by: Walter Graves **Date:** 6/04

Approved by: Michael R. Wright **Date:** 6/04

Hydrometrics, Inc.
3020 Bozeman Avenue
Helena, MT 59601

REVISION HISTORY

Revised by: Mark T Walker **Date:** 10/2010

TABLE OF CONTENTS

1.0 SCOPE AND APPLICATION

HSOP-4 presents procedures to be followed when shipping samples of environmental media (e.g., air, water, soil, waste material) to a laboratory for analysis. All samples submitted should be accompanied by chain-of-custody documentation.

2.0 SUMMARY OF METHOD

Samples of environmental media submitted to laboratories for analysis are often shipped via commercial carrier. Samples are packed in shipping containers to minimize the potential for container breakage or leaking. Each shipment will be accompanied by sample documentation, including chain-of-custody forms and a list of required analytical parameters, methods, and detection limits. Samples are cooled with ice during transport, to maintain temperature at approximately 4°C (±2°C). Shipments of hazardous materials must conform to International Air Transport Association (IATA) Dangerous Goods regulations and/or Department of Transportation (DOT) regulations, as well as any carrier-specific requirements.

3.0 HEALTH AND SAFETY WARNINGS

Field personnel should be aware of the health and safety precautions to be followed during any field event, and should be familiar with any project-specific hazards. This may include review of project-specific health and safety plans, site-specific and/or organization-specific safety requirements and training.

- Care should be exercised when handling samples of hazardous or potentially hazardous waste. Personal protective equipment (PPE) should be utilized (gloves, safety glasses, coveralls) as appropriate.
- Glass sample containers should be handled with extreme care to avoid breakage, loss of sample, and possible injury.

4.0 INTERFERENCES

Not Applicable

5.0 PERSONNEL QUALIFICATIONS

Personnel should be familiar with the project work plan and objectives, and with the operation of equipment listed in Section 6.0 below. Personnel should also familiarize themselves with the schedule of the shipping location to be used for shipping samples. For projects involving hazardous materials, consult the project work plan, courier regulations,

and any state and federal air or ground shipping regulations for details on shipping hazardous material.

6.0 EQUIPMENT AND SUPPLIES

- Shipping container (metal or plastic cooler);
- Packing material (bubble wrap, Styrofoam peanuts);
- Absorbent material (clay absorbents, rock wool);
- Shipping tape;
- Shipping strap;
- Custody seals;
- Chain-of-custody (COC) forms;
- Heavy-duty or contractor grade garbage bags or similar plastic bags;
- Ziploc bags; and
- Ice.

7.0 CHAIN-OF-CUSTODY PROCEDURE

1. Chain-of-custody involves ensuring that samples are traceable from the time of collection until received by the analytical laboratory. The laboratory is responsible for custody during processing and analysis. A sample is under custody if:

    - It is in your possession;
    - It is in your view, after being in your possession; or
    - It was in your possession and you then placed it in a designated secure or locked area to prevent tampering.

2. When ready to ship samples, set out samples in a clean, secure area to complete chain-of-custody forms. Chain-of-custody forms may be obtained from the project laboratory, or from Hydrometrics' Data Quality Department. An example COC form is shown in Attachment 1. Each sample should be identified on the form by its sample number, date and time of collection, and analysis requested. Check sample labels against information recorded in field notebook and on chain-of-custody to ensure consistency and guard against transcription errors (HSOP-29). It is usually best to use one chain-of-custody form per shipping container, covering the samples included in the container. When shipping multiple coolers to the laboratory, label chain-of-custody forms as "Cooler 1 of 3," "Cooler 2 of 3," etc. While chain-of-custody forms obtained from various sources may differ, certain information regarding sampling dates and times, sample identification, contact information, and requested parameters for analysis should be included on all acceptable forms. Complete all fields on the chain-of-custody form, as applicable to the

particular sampling event. Examples of typical COC information to be completed are as follows:

a) **Company Name:** Enter "Hydrometrics, Inc."

b) **Project Name:** Enter the project name and Hydrometrics' project number

c) **Report Mail Address:** Enter the name, address, and e-mail address of the person who should receive the laboratory report.

d) **Contact Name:** Enter the name of the project manager, sampling personnel, or other responsible contact.

e) **Phone/Fax:** Enter the phone and fax number of the contact person for the project.

f) **E-mail:** Enter the e-mail address for the contact person.

g) **Sampler:** Print the name of the person who collected the samples.

h) **Invoice Address:** Enter the address where the invoice should be sent.

i) **Invoice Contact and Phone:** Enter the name and phone number of the person responsible for approving the invoice.

j) **Purchase Order:** Enter the Hydrometrics' Purchase Order number for the sample order.

k) **Quote/Bottle Order:** Enter the laboratory quote number for the project or bottle order number provided with the sample bottle order.

l) Note any special reporting requirements or formats.

m) **Sample Identification:** Enter the unique sample number assigned to the sample.

n) **Collection Date:** Enter the date each sample was collected. Do not use ditto (") marks, arrows or lines to represent the same date.

o) **Collection Time:** Enter the time each sample was collected. Do not use ditto (") marks, arrows or lines to represent the same time.

p) **Number of Containers and Matrix:** Enter the number of bottles the sample is contained in followed by a dash and then a letter representing the type of sample matrix (i.e. A=Air, W=Water, S=Soil/Solid, V=Vegetation, B=Bioassay, O=Other).

q) **Analysis Requested:** Write the analysis to be performed on each sample and check the box for each sample you want to receive this analysis. Also include an analytical parameter list.

r) **Remarks:** Use this field to make notes or comments to the laboratory.

(Note: If a laboratory-provided COC form is used, be sure to follow any additional instructions included from the laboratory.)

3. Record shipping information (tracking numbers, name of courier, other pertinent information) on chain-of-custody form. Sign and date chain-of-custody form, and retain one copy of form for project file.

8.0 PACKING AND SHIPPING PROCEDURE

1. Seal drain holes in bottom of shipping cooler (inside and out) to prevent leakage. Check sample container lids to ensure they are tightly sealed.

2. Line bottom of cooler with packing material (bubble wrap). Open and place two heavy-duty plastic bags in cooler (one inside the other).

3. Seal samples within individual plastic or bubble wrap bags, as necessary. All glass containers (VOAs, amber glass bottles, glass soil jars) should be placed in individual bubble wrap bags. Place sealed sample containers in shipping cooler, inside double plastic bags. In most instances, a labeled temperature blank should be included with the samples to allow the laboratory to check the sample temperature upon arrival. The temperature blank is generally a small vial or bottle filled with tap water and labeled "Temperature Blank." Ensure that temperature blank meets temperature requirements upon receipt by laboratory.

4. Cover samples with ice, inside double plastic bags.

5. Close and seal double plastic bags, by knotting or with shipping tape. Fill any empty space in cooler with additional packing material or absorbent material.

6. Record shipping information (tracking numbers, name of courier, other pertinent information) on chain-of-custody form. Sign and date chain-of-custody form, and retain one copy of form for project file.

7. Place original chain-of-custody, sample parameter list, cover letter, and any other documentation needed by the laboratory into a plastic Ziploc bag. Seal Ziploc bag and tape to the inside of the shipping container lid.

8. Label outside of shipping container with sampling organization name, address, and phone number, laboratory destination name, address, and phone number, and any required DOT shipping labels.

9. Place custody seals on front and back of cooler (see Attachment 2) and tape in place with shipping tape to avoid accidental breakage. Wrap cooler securely in at least two places with a minimum of three wraps of shipping tape. Shipping strap may also be used to provide additional insurance against the cooler opening during shipment.

10. Deliver sample containers to the shipping location. Since samples should reach the laboratory as soon as possible to protect sample integrity, **overnight shipping is required,** unless unavailable at the shipping location. Retain copies of shipping receipts for the project file. Shipping receipts and tracking numbers serve as chain-of-custody documentation during sample transport from the sampler to the laboratory.

11. Additional guidance may be found in the EPA's *Contract Laboratory Program Guidance for Field Samplers* (EPA, 2004). More stringent shipping requirements may apply to samples collected under CLP protocols. The project work plan should be consulted to determine any special requirements.

9.0 DATA AND RECORDS MANAGEMENT

The following documents generated during sample packing and shipping will be retained in the project file:

- Chain-of-custody form;
- Analytical parameter list;
- Cover letter; and
- Shipping receipts.

10.0 QUALITY CONTROL/QUALITY ASSURANCE

- Field personnel should cross-reference information on sample labels, in the field notebook, and on sample chain-of custody forms during the sample packing and shipping process.
- Data quality review will include checking of sample documentation to ensure consistency.
- Temperature blank measurements by the laboratory upon arrival of samples will document that samples were maintained at the appropriate temperature during shipping.

11.0 REFERENCES

EPA, 2004. Contract Laboratory Program Guidance for Field Samplers (Draft Final). EPA 540-R-00-003. January, 2004.

Hydrometrics HSOP-29: Labeling and Documentation of Samples

CHAIN OF CUSTODY RECORD

Hydrometrics, Inc.

3020 Bozeman Ave. • Helena, MT 59601 • (406) 443-4150

PROJ. NO.	PROJECT NAME

SAMPLERS: *(Signature)*

DATE	TIME	COMP	GRAB	SAMPLE NUMBER	NO. OF CON-TAINERS	Commons UF / RAW	Nutrients UF / H_2SO_4	Diss. Metal F / HNO_3	CN UF / NaOH	Total Metals UF / HNO_3	Total Recoverable Metals UF / HNO_3	BTEX	TPH								REMARKS

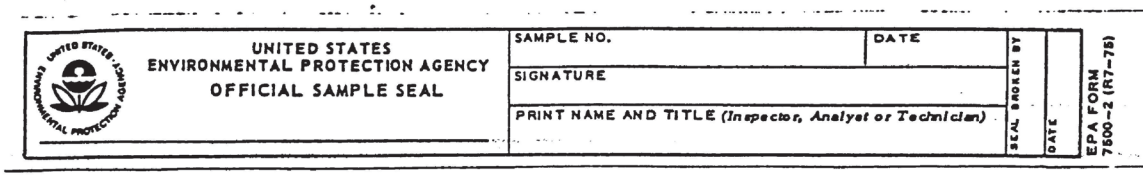
Attachment 1
Example Chain-of-Custody Form

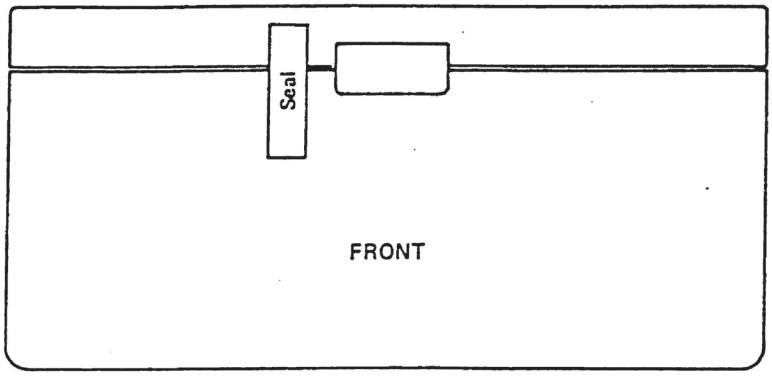
Relinquished *(Signature)*	Date / Time	Received by *(Signature)*	Lab	P.O. #	Shipped via: Bus FedEx UPS Other _____ Air Bill # _____
Relinquished *(Signature)*	Date / Time	Received by *(Signature)*	Remarks		
Relinquished *(Signature)*	Date / Time	Received for Laboratory by *(Signature)*	Date / Time	Enclosed: ❑ Parameter sheet w/detection limits ❑ QA / AC standard mixing instructions ❑ Cover letter ❑ Other _____	
				Split Samples: ❑ Accepted ❑ Declined _____ Signature	

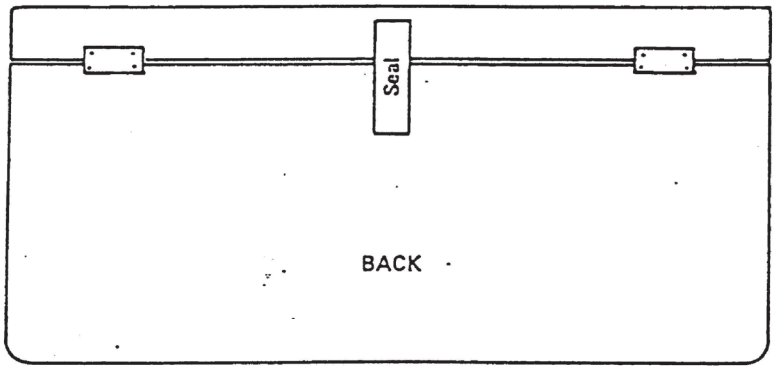
HFORM-1 07/11
TNO 406-443-8550

Return results & electronic copy to:
QA / QC Dept. at address at top of page

Attachment 2: Example of Custody Seals and Placement







HSOP-7

DECONTAMINATION OF SAMPLING EQUIPMENT

Prepared by: _____ **Date:** 6/04

Reviewed by: _____ **Date:** 6/04

Approved by: _____ **Date:** 6/04

Hydrometrics, Inc.
3020 Bozeman Avenue
Helena, MT 59601

REVISION HISTORY

Revised by: _____ **Date:** 01/2014

Reviewed by: _____ **Date:** 01/2014

Approved by: _____ **Date:** 01/2014

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1.0 SCOPE AND APPLICATION

HSOP-7 presents general procedures to be followed to decontaminate reused sampling equipment between sampling locations. Examples of equipment that may require decontamination are:

- Non-disposable air sampling equipment;
- Water level probes;
- Reusable bailers;
- Containers used to obtain composite samples;
- Water filtration apparatus;
- Concrete or soil coring devices; and
- Drill rig or other heavy equipment.

2.0 SUMMARY OF METHOD

Sampling equipment is cleaned between sampling locations to minimize the potential for cross-contamination. Basic decontamination procedures consist of soap and water, tap water, and/or deionized water rinses. More involved decontamination procedures may be specified and described in the project work plan or Quality Assurance Project Plan (QAPP).

3.0 HEALTH AND SAFETY WARNINGS

Minimum personal protective equipment (PPE) to be worn during decontamination procedures consists of safety glasses or goggles, latex or nitrile gloves, and steel-toed safety boots. Additional PPE may be required by the work plan or project Health and Safety plan. Use caution when handling organic solvents and non-phosphate detergents to prevent spills, leaks, or contact with incompatible materials. Also, ensure that ventilation is adequate when using volatile solvents for decontamination. Material safety data sheets (MSDS) for all chemical substances used during decontamination should be available at the site where decontamination activities are performed.

4.0 INTERFERENCES

Not Applicable

5.0 PERSONNEL QUALIFICATIONS

Personnel conducting decontamination activities should be familiar with the usage of the equipment being cleaned, and with the intended suite of analytes for samples collected with the equipment, if any. Additional training such as 40-hour HAZWOPER certification may be required for decontamination of equipment that has contacted hazardous material.

6.0 EQUIPMENT AND SUPPLIES

- Tap water;
- Deionized water;
- Organic solvent (acetone, hexane, methanol);
- Non-phosphate detergent;
- Plastic sheeting;
- Pressure washer;
- Latex or nitrile gloves;
- Buckets; and
- Brushes.

7.0 PROCEDURE

1. Select an appropriate area for cleaning and drying equipment to be decontaminated. The area should be free of potential contaminants and sheltered from inclement weather (if possible). Cover decontamination area with plastic sheeting if necessary.
2. Disassemble any equipment that may have trapped material within components.
3. For equipment used to sample for inorganic constituents, the following three-step process is usually sufficient for decontamination:

    - Wash equipment in warm water and non-phosphate detergent, scrubbing with brushes as necessary to remove visible contaminants;
    - Rinse equipment with clean tap water;
    - Rinse equipment with deionized (DI) water and air dry.

    For organic parameters, decontamination of water or soil sampling equipment may require additional steps:

    - Rinse equipment with solvent (hexane, acetone); and
    - Rinse equipment with DI water and air dry.

    Note that organic solvents will not be used for decontamination when cleaning equipment for use in collecting volatile constituents in air samples.

4. Rinse water from decontamination should be disposed of according to work plan requirements. Moderate quantities of non-hazardous rinse water can typically be disposed of on the ground. Organic solvents should be containerized and disposed of in accordance with local environmental regulations.
5. Heavy equipment used for sampling purposes (including drill rig auger flights and tools) should be cleaned as necessary between sampling locations with a hot- or cold-water pressure washer. If practical, soap and water may be used to scrub equipment as well.

6. DI water should be obtained from a source with documented capability to produce contaminant-free water. The source of DI water used and other specifics of decontamination procedures should be recorded in the field notebook.
7. Drying and storage of decontaminated equipment should be in a contaminated-free, protected area if possible. Equipment that will not be used again immediately may be storage in plastic bags or other clean containers for additional protection.

8.0 DATA AND RECORDS MANAGEMENT

Decontamination procedures will be documented in the field notebook, which is maintained in accordance with HSOP-31.

9.0 QUALITY CONTROL/QUALITY ASSURANCE

The effectiveness of decontamination procedures and the potential for cross-contamination of samples may be assessed through the collection and analysis of equipment rinsate blank samples, as described in HSOP-13. In general, equipment rinsate blank collection involves thoroughly decontaminating sampling equipment, then rinsing the clean equipment with deionized water, and capturing the rinse water in containers to be submitted to the laboratory for the parameters of interest. The project work plan and QAPP should be reviewed for project-specific directions regarding collection and analysis of equipment rinsate blanks.

10.0 REFERENCES

Hydrometrics HSOP-13: Equipment Rinsate Blank Collection

Hydrometrics HSOP-31: Field Notebooks

STANDARD OPERATING PROCEDURE

WATER LEVEL MEASUREMENT WITH AN ELECTRIC PROBE

HF-SOP-10

1.0 PURPOSE

This procedure applies to all water level measurements obtained using an electric probe. Normally, this procedure is used for measurement of water levels in wells. All electrical probes used, such as an Olympic Well Probe or Solinst, must have permanent depth markers placed at a minimum of every five feet on the probe wire or must have a direct reading tape.

2.0 EQUIPMENT

- Electronic probe;
- Water level measurement form (**HF-FORM-430**, Water Sampling Form);
- Field notebook; and
- Probe calibration data.

3.0 PROCEDURE

The water level is obtained by lowering the probe until contact is made between the probe tip and the water surface. The contact point is carefully checked by a slight lowering and raising of the probe and simultaneously observing the needle deflection, buzzer or light on the meter. For accurate measurements, the wire line must be straight as the probe is lowered. This is particularly important for the first few feet of line. Water depth is determined by direct reading of the probe wire or by measurement of the wire to the center of the nearest large marker and addition or subtraction from the marker value.

Water level measurements are referenced to the measuring point (MP). Normally, the MP is the top of a well casing but may be some other point. The MP used must be described. The north edge of the casing is usually marked or notched and all water level measurements are referred to this marked point.

3.1 CALIBRATION

All electric probes must be periodically calibrated. Normally, calibration is once or twice per year but, if the probe has been rebuilt, stretched, or replaced, it also must be recalibrated. For

recalibration, the electrical line is laid out on a flat surface and stretched to approximate its normal hanging weight. A steel tape graduated in 0.01 foot increments is used to determine probe accuracy. Additionally, the probe must be placed in wells with differing water levels and water depth measured and compared with a steel tape. A calibration record with correction factor is developed and placed in the equipment calibration file. This calibration record is used in the field to correct probe readings.

3.2 MEASUREMENT ACCURACY

All water levels and calibrations are normally measured to the nearest 0.01 foot. Probe data are considered accurate to 0.05 feet under good measurement and calibration conditions and to 0.10 feet under normal conditions. For deep or difficult conditions, accuracy may be less than 0.10 feet.

3.3 PROBE DECONTAMINATION

For projects where cross-contamination of wells may be a problem, the well probe and line must be decontaminated between measurement sites. This is particularly important when measuring wells containing substances such as PAH (polyaromatic hydrocarbons), pesticides, petroleum products and some metals.

Decontamination must include cleaning the probe and wire line. Most organics can be removed by wiping the line, then using detergent in water followed by acetone or methanol, followed by rinsing with DI (deionized) water.

Many inorganics can be removed by wiping the wire line and rinsing the probe in DI water. Specific attention must be paid to any sediment, rust or dirt on the wire line.

Water Sampling Form ~~ HF-430

Hydrometrics, Inc.
Consulting Scientists and Engineers

Project Name: _____ **Site Designation:** _____
Project Code: _____ **Sample Code Number:** _____
Sample Team Member(s): _____ **Sample Date:** _____
Laboratory Used: _____ **Sample Time:** _____ (military)

If Duplicate Sample Collected, Please Record Below

Duplicate Sample Code #: _____
Duplicate Sample Time: _____

Site Conditions

New Site: Yes No Photo taken: Yes No
Site Type: DRY surface water process water
monitoring well domestic well adit seep
spring– other: _____
Weather Conditions: calm breeze windy
no precip. rain snow
clear p. cloudy overcast
Air Temperature: ° C ° F

For Groundwater Samples

well volume formula: $V = \frac{(TD-SWL)x(Dia.^2)}{25}$ Comments

TD (ft): _____
SWL (ft): _____ no access/pumping
Casing Diameter (I.D."): _____
Water Volume (V) (gal): _____
x 3=(gal.) _____
Actual Vol. Removed (gal.) _____
Water Level Recovery: slow moderate rapid

For Surface Water Samples

Flow Method: Marsh McBirney Volumetric Flume Weir Estimate
Other Flow or Description: _____
Flow: gpm cfs Staff Gage:

Field Parameter Stabilization

Time (military)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/l)	pH	S.C. (µmhos/cm)	Turbidity (n.t.u.)	Temperature (°C)	Additional Parameters or Notes

Turbidity: (circle) clear moderate slight very

Sample Method: (describe) grab composite pump bailer other
large peristaltic

Field Parameters

	Sample	Duplicate
ORP (mV)		
DO (mg/l)		
pH		
SC (µmhos/cm)		
Turbidity (ntu)		
H_2O Tmp. (°C)		
Color		
Other: _____		

Bottles Collected

Quantity	Size	Filter or Unfilt.	Preservative	Parameter	Additional Notes
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			

Comments: _____

Sample Team Member Signature: _____ Page of

HSOP-31

FIELD NOTEBOOKS

Prepared by: _____ **Date:** 6/04

Reviewed by: _____ **Date:** 6/04

Approved by: _____ **Date:** 6/04

Hydrometrics, Inc.
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Helena, MT 59601

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1.0 SCOPE AND APPLICATION

HSOP-31 presents general guidance on recording field activities in a dedicated project notebook. Field books are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the implementation of the project. In legal proceedings, field notes are typically admissible as evidence and subject to cross-examination.

2.0 SUMMARY OF METHOD

Bound notebooks with sequentially numbered pages are used to record observations, sampling information, weather conditions, and other pertinent information during field activities. Entries are made in permanent ink, and signed and dated at the bottom of each page. Both original notebooks and copies of field notes are retained as part of the project file.

3.0 HEALTH AND SAFETY WARNINGS

Field personnel should be aware of the health and safety precautions to be followed during any field event, and should be familiar with any project-specific hazards. This may include review of project-specific health and safety plans, site-specific and/or organization-specific safety requirements and training.

4.0 INTERFERENCES

The primary potential problem with recording information in field notebooks is dealing with incorrect entries. In no case should erasures be made or information be obliterated or made illegible. Errors should simply be crossed out with a single line, dated, and initialed by the person making the original entry.

5.0 PERSONNEL QUALIFICATIONS

No specific qualifications are necessary for recording information in field notebooks. Personnel should be familiar with the scope and objectives of the project in order to record more meaningful field observations.

6.0 EQUIPMENT AND SUPPLIES

- Bound notebook with water resistant, sequentially numbered pages
- Pen (indelible ink)

7.0 PROCEDURE

1. New field notebooks should be labeled with the project title and number on the cover. Inside the front cover, write Hydrometrics' address and phone number as contact

information, in case the notebook is lost. Multiple field notebooks may be required for large or ongoing projects; these should be assigned sequential numbers or labeled on the cover with the inclusive dates of observations recorded in the notebook (e.g., Project X, May 2002 through May 2004).

2. Notebook entries should begin on a fresh page for each day during a field event. While specific entry formats may vary with personal preference, the intent of the field notebook is to provide a daily record of significant events, observations, and measurements, as well as sampling information. All entries should be accompanied by date and time. Examples of information to be recorded in the field notebook includes:

    - Weather conditions;
    - Personnel on-site, including arrival and departure times and identities of visitors and observers;
    - Purpose of daily activities;
    - Site sketch maps;
    - Health and safety briefing information;
    - Field meter calibration information;
    - Identification and description of sampling sites (see HSOP-2); and
    - Descriptions of photos taken;
    - Communication logs;
    - Documentation of deviation from methods;
    - Sampling instrument decontamination records.

    Sampling-specific information should include (see also HSOP-29):

    - Sample number, date, and time;
    - Site identifier;
    - Description of sample containers, preservation, and sample collection method;
    - Sample tag number (if applicable);
    - Field parameter measurements and water calibration (static water level, total well depth, pH, specific conductance, water temperature, turbidity, color, odor, etc.); and
    - Soil depth intervals and descriptions.

    This list is not meant to be exhaustive, and other pertinent information should also be recorded in the field notebook as determined by field personnel.

3. The field notebook will be used to record communication with individuals on-site and on the phone that could result in a deviation from the SAP or that could impact the quality of the data being collected as part of the investigations.

4. Observations and measurements should be recorded in indelible ink, at the time they are made.

5. If erroneous entries are recorded, corrections should be made by deleting incorrect information with a single line, and dating and initialing the deletion in the notebook. Do not erase or obliterate incorrect entries, or remove pages from the notebook.
6. Blank and unused portions of notebook pages should be crossed out with a single line.
7. At the conclusion of the field event, review notebook entries, sign and date each page (if not already done), and photocopy notebook pages for inclusion in the project file. Original notebooks may be maintained in the project file, or in the files of individual field personnel at the discretion of the project manager.

8.0 DATA AND RECORDS MANAGEMENT

Copies of field notes are retained in the project file. Original field notebooks are maintained in the project file, or in the files of individual field personnel at the discretion of the project manager. Completed (filled) notebooks should be placed in the project files or the Data Quality Department notebook library, at the discretion of the project manager. Copies of field notebooks should be updated in project files at the end of each field event.

9.0 QUALITY CONTROL/QUALITY ASSURANCE

Standard procedure requires review of field notes by a person other than the person who recorded the field notes, prior to entering the information into the project files, to check for inaccurate, incomplete, or unclear entries, blank pages, or other problems with documentation. Peer review of notebook entries should also be conducted at least once per day during field activities.

10.0 REFERENCES

Hydrometrics HSOP-2: Determination, Identification, and Description of Field Sampling Sites

Hydrometrics HSOP-29: Labeling and Documentation of Samples

STANDARD OPERATING PROCEDURE

DECONTAMINATION PROCEDURE FOR ORGANICS SAMPLING EQUIPMENT© HF-SOP-35

1.0 PURPOSE

Because organics are commonly present and detectable at very low concentrations, a special procedure is used to ensure complete decontamination of equipment used in organics sample collection. This procedure applies specifically to bailer or bladder pump, but may be adapted to decontaminating other sampling equipment as well.

2.0 EQUIPMENT

Teflon/Stainless Steel Bladder pump and teflon hose, or teflon, acrylic, or stainless steel bailer.

- Non-phosphate soap
- Scrub brush
- Teflon tape
- Fresh, clean water
- Acetone (ACS reagent grade or better)
- 3 large water-tight containers
- Squirt bottle with reagent or pesticide grade hexane
- Deionized water
- Water-tight container for bladder pump or bailer

Note: Acetone and hexane are flammable liquids and potential environmental contaminants, so appropriate care must be exercised to avoid ignition and prevent spills.

3.0 PROCEDURE

General decontamination procedures for organic contaminants:

A) Wash with non-phosphate detergent/tap water mixture.

B) Rinse with tap water.

C) Rinse with deionized water.

D) Rinse with 5% pesticide grade acetone/tap water solution, allow to air dry.

E) Rinse with pesticide grade hexane.

F) Allow equipment to air dry completely before storage or reuse.

Bladder pump decontamination procedures for organic contaminants:

A) Obtain 3 large water-tight containers (30 gallon galvanized steel trash cans may be used) and decontaminate thoroughly by washing with a non-phosphate detergent and rinsing with tap water.

B) Partially fill each of the three containers with the following liquids:

1) Container No. 1 should contain a mixture of non-phosphate detergent and tap water.

2) Container No. 2 should contain tap water.

3) Container No. 3 should contain a tap water solution containing 5% pesticide grade or reagent grade acetone.

C) Take the bladder pump apart in container No. 1 (nonphosphate detergent/tap water) and scrub thoroughly with a brush. Put the pump back together making sure to use new teflon tape on all thread fittings. Now pump approximately 3 to 5 gallons of the detergent/tap water mix through the pump. Also, any portion of the pump tubing that may potentially contact the groundwater or contaminants should be decontaminated.

D) Next, rinse the pump with tap water and then place in container No. 2 (tap water). Pump approximately 10 gallons of tap water through the pump.

E) After pumping tap water through the bladder pump, place the pump in container No. 3 (acetone/tap water) and pump approximately 2 gallons of this solution through the pump.

F) Now remove the pump from container No. 3 and use a small squirt bottle filled with pesticide or reagent grade hexane to rinse the outside of the pump. Allow the pump to air dry completely after rinsing with the hexane.

G) After the pump has had sufficient time to air dry, place the pump in a decontaminated sleeve type container (a PVC tube may be utilized for this). Now fill the sleeve container with DI (de-ionized) water and pump approximately 2 gallons of DI water through the pump. DI water utilized for organics decontamination should be contained in decontaminated glass or nonreactive containers. Pump is now decontaminated and ready to use for sampling. If the pump is to be transported prior to sampling, the top of the sleeve container should be covered to prevent contaminants from entering.

H) After sampling has been completed, a dedicated sleeve type container should be used to transport the pump to the location used for decontaminating the sampling equipment. If the pump is to be decontaminated on-site, this step may be omitted.

Bailer decontamination:

A) Items (A) and (B) above.

B) Wash the bailer in container No. 1 and rinse in containers No. 2 and 3. After cleaning, ensure that bailer does not become contaminated.

4.0 ASSOCIATED REFERENCE

National Water Well Association, Sept. 1986, RCRA Groundwater Monitoring Technical Enforcement Document.

STANDARD OPERATING PROCEDURE

SAMPLING MONITORING WELLS FOR ORGANIC PARAMETERS

HF-SOP-38

1.0 PURPOSE

This procedure describes the methods to be used in collection of groundwater samples from wells and is designed for wells where organic constituents are the major concern.

2.0 EQUIPMENT

Bailer, Teflon bladder pump (see **HF-SOP-6**), pre-cleaned glass sample vials with Teflon-lined lids, nylon rope, and water level electric probe. Any equipment which contacts the sample (pump, tubing, bailer, etc.) MUST be made of a material that will not contaminate the sample with organics. This includes stainless steel, Teflon, or acrylic. **PVC may NOT be used**. A trip blank(s) should be obtained from the laboratory in advance of the planned sampling event.

Other sampling equipment may be required for specific tasks. Other general equipment may include:

- Trip Blank (this is supplied in advance by the laboratory);
- Distilled water;
- Sampling sheets;
- Samplers notebook;
- Coolers;
- Preservatives;
- Chemical-free paper towels; and
- Properly cleaned sample containers (purchase of pre-cleaned containers is recommended). Minimum volume is 40 mL for volatiles.

3.0 PROCEDURE

A. Unlock and open the well.

B. Obtain water level (see water level SOP - **HF-SOP-10**).

C. To operate bladder pump, see **HF-SOP-6**. Be sure that bladder pump or bailer has been thoroughly decontaminated prior to placing in the well. The decontamination

procedure for organics sampling equipment is explained in **HF-SOP-35**. Use a separate clean, new nylon rope or cord to retrieve the bailer from each well.

D. Purge well with appropriate water removal device. Direct pump or bailer discharge to a bucket or container to determine purge rate. Monitor pH and conductivity until values stabilize to determine the appropriate purge volume. A total of three well bore volumes of water are normally removed.

E. Collect samples after a sufficient purge volume has been withdrawn. Fill bottles directly from the bailer or the pump hose. Considerable care should be taken to minimize entrainment of air; close the container lid tightly without allowing any bubbles to remain in the sample. Vials must be filled to the brim, and have zero headspace; this is particularly important for volatile organics.

F. After the bottles are filled, add the appropriate preservatives, if required, and place in iced cooler immediately. Preservatives and permissible handling times appropriate for certain organic parameters are listed in **HF-SOP-32**.

G. Decontaminate sampling equipment according to procedure described in **HF-SOP-7**.

4.0 ASSOCIATED DOCUMENTS

A. Decontamination of Sampling Equipment **(HF-SOP-7)**

B. Obtaining Groundwater Samples with a Bladder Pump **(HF-SOP-6)**

C. Sampling and Preservation of Organic Parameters -- Water and Wastewater **(HF-SOP-32)**

D. Water Level Measurement with an Electric Probe **(HF-SOP-10)**

The following forms will be completed and retained in the project file:

A. Water Sampling Form **(HF-FORM-430)**;

B. Chain-of-Custody Form **(HF-FORM-1)**; and

C. Shipping receipts.

STANDARD OPERATING PROCEDURE

FIELD OR LABORATORY MEASUREMENT OF TURBIDITY©
HF-SOP-53

1.0 PURPOSE

A portable AC-powered ratio turbidimeter is used to measure sample turbidity in standard nephelometric turbidity units (NTU). The instrument is calibrated with secondary standards, is unaffected by sample color, and can measure sample turbidities up to 199 NTU.

2.0 EQUIPMENT

A. Instruments

1. Hach Model 18900 Ratio Turbidimeter
2. Light shield
3. Dust cover

B. Additional Equipment

1. Sample Cells
2. Secondary and Stray Light Standards
3. Silicone Oil
4. Lint-free polishing cloth

C. Reagents

1. Particle-free Distilled water
2. Detergent and glass cleaner

3.0 PROCEDURE

A. Equipment Set-Up

1. Place instrument on flat and stable surface where storage temperature is between -20 and 60°C and operating temperature is between 10 and 45°C.

2. Power supply must be 115 V, unless instrument is reconfigured for 230 V as described in the Hach manual.

3. Prior to calibration, allow 15 minutes for the instrument to warm up. Remove dust cover prior to turning on the instrument.

B. Turbidimeter Calibration

1. The turbidimeter is calibrated for routine use with Gelex ® secondary standards. These secondary standards are determined using the turbidimeter after it has been calibrated using two primary formation standards, as discussed in the Hach manual. Calibration with the primary formation standard is only necessary when the instrument is out of tolerance (5%) or every six months. As additional equipment is required for calibration using the primary standard, the reader is referred to the Hach instruction manual.

2. For routine calibration using the secondary standards, select the turbidity range in which you will be working.

3. Select the appropriate secondary standard, and check to be sure that the cell is completely clean. Coat cell with thin layer of silicon oil if scratches or imperfections are evident.

4. Place the cell into the cell holder. Place the light cover over the cell holder. Read the turbidity (NTU's) and verify that the observed value in within 5% of the established standard value written on the tube. Repeat the procedure for all analytical ranges if you are unsure of your sample range. If the secondary standard is not within 5% of stated value, the instrument requires recalibration with primary formazin standards, refer to the manual.

C. Turbidity Measurement

1. Fill a clean sample cell to the line marked on the cell. Be sure that the cell exterior is clean and free of finger prints, dust, scratches, etc. Do not use scratched or dirty cells. Remove air bubbles by tapping or inverting cell.

2. Place cell into sample cell holder and place light cover over holder. Sample should be at room temperature to prevent formation of condensate when placed into the light beam. Orientation of the cell can affect reading, an index mark is found on the cell and should be aligned in the same direction for every measurement.

3. Select appropriate analytical range. If unknown, start with highest range and work down.

4. After 15 or 20 seconds, read stabilized value. If value is above the range you have selected, a 1.__ reading will be obtained. If value is below the range you have selected, a reading __.1 will be obtained. If value is erratic (probably due to particulate floating in and out of beam), refer to Hach

manual. If sediment precipitates in tube, a sharp drop in the turbidity may be noted within 1 minute.

5. At low range (less than 1 NTU), the greatest accuracy will be obtained if stray light values greater than 0.05 NTU, as determined using the stray light standard, are subtracted from the measured sample turbidity. Subtract 0.05 NTU from the stray light standard measurement to obtain a stray light correction factor. For example, if stray light measured using the standard is 0.07 NTU, subtracting 0.05 to account for the maximum standard value yields a correction factor of 0.02 NTU.

6. Following measurement of all samples, return the light cover to the sample cell holder and set the range to 0 to 2.

7. Turn off the power and replace the dust cover. Clean sample cells, taking care not to chip or scratch the cells such that they are not optically consistent.

4.0 REFERENCES

Hach Company, 1989. Instruction Manual for Ratio Turbidimeter Hach Model 18900.

APHA, AWWA, WPCF, 1985. Standard Methods for the Examination of Water and Wastewater. 16th Edition. Method 214.

HSOP-105

LOW FLOW/MINIMAL DRAWDOWN GROUNDWATER SAMPLING FOR MONITORING WELLS

Prepared by: _____ **Date:** 10/2010

Reviewed by: _____ **Date:** 10/2010

Approved by: _____ **Date:** 10/2010

Hydrometrics, Inc.
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Helena, MT 59601

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1.0 SCOPE AND APPLICATION

Collection of representative groundwater samples requires the use of appropriate standard procedures, using equipment and methods that will maintain the chemical, physical, and biological integrity of the water sample and therefore accurately represent the characteristics of groundwater within the aquifer. Typically, groundwater samples are collected using a "standard purge procedure," where a minimum number of well volumes are purged from the well while monitoring field parameters for stabilization, and samples are collected after removal of the required volume of water has occurred and stabilization of parameters has been demonstrated (USGS, 2006). In certain circumstances, however, use of an alternative low flow/minimal drawdown purging and sampling technique is warranted. HSOP-105 presents guidelines for implementing the low flow/minimal drawdown purging and sampling method for groundwater sampling.

The methods described in HSOP-105 are based primarily on a Standard Operating Procedure for low-stress (low-flow) minimal drawdown groundwater sample collection developed by the U.S. Environmental Protection Agency (Yeskis and Zavala, 2002). The EPA reference should be consulted for additional suggestions and guidance on performing low-flow sampling. The purpose of this procedure is to provide a sampling method that will (1) minimize the potential impact of purging on groundwater chemistry, and (2) minimize the volume of purge water requiring disposal.

Implementation of the low-flow purging and sampling procedure will usually be specified in project planning documents (work plans, field sampling plans, and/or quality assurance plans). In general, HSOP-105 should be implemented at monitoring wells with a screen length of ten feet or less. While dedicated equipment is preferred to minimize potential disturbances due to placement of pumping equipment, the method may also be employed using non-dedicated equipment. Groundwater samples for the full spectrum of chemical constituents may be collected using the low-flow purge technique, including metals and other inorganics, and organic compounds (e.g., volatile, semi-volatile, PCBs, pesticides, herbicides).

This method is not generally applicable to water supply wells, which usually include dedicated pumps without the ability to accurately control purge rates. The low-flow method should not be used when non-aqueous phase liquids (NAPLs) are present within the well.

When performing low flow sampling on Montana Department of Environmental CECRA sites, these procedures should be compared to the DEQ's low flow sampling guidelines memo: SRS Low-Flow Purging and Sampling Guidelines (MDEQ, 2005). In the event of discrepancies in procedure, the DEQ guidelines should be followed.

2.0 SUMMARY OF METHOD

The low-flow purging and sampling method consists of the following steps:

- Measurement of the depth to groundwater;
- Installation of pumping equipment (if non-dedicated equipment is used) so that the pump intake is located at an appropriate location within the screened interval;
- Purging of the well at a low flow rate to maintain less than 0.33 feet of drawdown;
- Monitoring of field parameters at regular intervals (3 to 5 minute intervals are recommended for typical flow rates) to ascertain stabilization; and
- Collection of groundwater samples after field parameter stabilization has occurred.

3.0 HEALTH AND SAFETY WARNINGS

Field personnel should be aware of the health and safety precautions to be followed during any field event, and should be familiar with any project-specific hazards. This may include review of project-specific health and safety plans, along with site-specific and/or organization-specific safety requirements and training.

Hazards specific to groundwater sampling may include electrical shock hazards during operation of generators, pump control boxes, batteries, etc.; lifting hazards encountered during setting and retrieval of pumps; contact with groundwater and associated organic or inorganic contaminants; and contact with chemical preservatives. Appropriate personal protective equipment should be used at all times during field activities. Good field practice also includes setting aside time prior to, during, and following field activities to consider potential health and safety issues and their resolution (e.g., "tailgate" safety meetings).

4.0 INTERFERENCES

Problems with the low-flow purging and sampling procedure may occur with extremely low-yield wells, when drawdown of less than 0.33 feet cannot be maintained even at very low pumping rates. In general, these wells should be identified prior to field sampling, and a different purging/sampling technique should be utilized. However, if low-yield conditions are encountered during sampling using the low-flow method, the EPA SOP (Yeskis and Zavala, 2002) gives the following recommendations:

- Turn pump off prior to water level reaching the top of the screened interval and allow 15 minutes for recovery. A check valve is required if the pump is shut off.
- Do not pump well dry under any circumstances.
- Begin pumping at a lower flow rate; if water draws down again to near the top of the screened interval, again shut off pump and allow 15 minutes for recovery.
- If a minimum of two tubing volumes (pump tubing plus flow cell volume) have been removed during the purging procedure, sampling may proceed after the second recovery period.

5.0 PERSONNEL QUALIFICATIONS

Personnel should be familiar with the project planning documents (work plans, field sampling plans, and quality assurance plans), as well as the overall project objectives. Review of well logs and previous sampling documentation regarding well total depths, screened intervals, pump intake depths, pumping rates, field parameter measurements, and other pertinent information should be reviewed prior to field activities. Personnel should also be proficient with the operation of equipment listed in Section 6.0 below. Site safety and training requirements (including HAZWOPER training) must also be met as necessary.

6.0 EQUIPMENT AND SUPPLIES

Minimum equipment requirements for implementing the low-flow method for purging and sampling groundwater include the following:

- Device for measuring depth to water (electric water level probe or other device).
- Device for measuring well total depth (steel tape and weight or other device), if total depth measurement is required.
- Sampling pump and associated equipment (submersible, bladder, or peristaltic pump and tubing, power supply). Pumps and tubing should be constructed of inert materials appropriate for the target analytical constituents, such as stainless steel, high-density polyethylene, Teflon®, or similar materials. Pump tubing should be graduated to allow for accurate placement of the pump intake at a specified depth.
- Flow measurement equipment, such as an inline flowmeter, calibrated bucket and stopwatch, or graduated cylinder.
- Field parameter meters (multiple single-parameter type, or multiparameter meters) and flow-through cell. Indicator parameters for groundwater sampling typically include pH, specific conductance (SC), dissolved oxygen (DO), and water temperature. Turbidity measurements and oxidation-reduction potential (ORP) may also be monitored. The list of required field parameters will usually be included in the project planning documents. The flow-through cell should be relatively small (≤ 1 liter), and a manufactured and completely closed (threaded) cell is preferred. The discharge line to the flow-through cell should be separate from the discharge line used for collection of samples using the necessary fittings (usually tees and valves).
- Sample collection supplies (e.g., bottles, preservatives, filters, coolers).
- Sampling documentation materials (field notebook, field sampling forms or data sheets, chain-of-custody documentation).

7.0 PROCEDURE

1. Position vehicles for sampling such that any vehicle or generator exhaust is produced downwind of the sampling area.

2. Remove well cap and measure depth to groundwater from the designated measuring point (and total well depth, if required). Total well depth may also be obtained from well logs or previous measurements. Record information in field notebook and on field forms. Occasional re-measurement of depth to water is recommended to confirm initial measurement, and the reproducibility of the depth to water measurements.

3. Calculate one casing volume (volume of water in the casing) using the formula V=0.0408 x (TD-SWL) x (D^2), where TD is the well total depth (feet below measuring point), SWL is the depth to water (feet below measuring point), and D is the well casing inner diameter (inches). Record information in field notebook and on field sampling form.

4. For sampling with non-dedicated equipment, place the pump and tubing slowly and carefully into the well to avoid agitating the water or generating turbidity, setting the pump intake at the pre-determined location within the well screen interval, or at approximately the center of the screened interval if no location is specified. For dedicated systems, the pump will already be installed with the intake at the desired depth.

5. For sampling with non-dedicated equipment, remeasure the depth to water after the pump has been placed in the well, and record in field notebook and on field form. The water level probe or measuring device should be left in place at this time to allow for measurement of drawdown during the purging/sampling procedure.

6. Connect pump tubing to discharge line and flow-through cell line. Make electrical connections to allow operation of pump. Direct discharge line and flow-through cell waste line into containers to contain purge water, if required by the project sampling plan. Alternatively, direct purge water to the ground away from the well head and from electrical equipment.

7. Begin pumping at a low rate while monitoring drawdown using water level probe. Yeskis and Zavala (2002) recommend initial pumping at 0.2 to 0.5 liters per minute (less than 0.1 gallons per minute). Records from previous monitoring events may also provide guidance on appropriate pumping rates for a particular well. Slowly increase pump rate while maintaining drawdown of less than 0.33 feet. Record pump rates and associated water level measurements on field documentation. In addition to minimizing drawdown, the final pumping rate should be low enough to avoid producing excessive turbulence or high levels of turbidity within the well. In the absence of other information, this may indicate purge rates no greater than 1 gallon per minute for a 2-inch diameter well (Yeskis and Zavala, 2002). However, higher purge rates may be used for larger diameter wells, or if field parameter measurements, historic data, and/or drawdown measurements

suggest that higher pumping rates do not compromise the representativeness of groundwater samples.

8. Estimate one "tubing volume" (volume of water in the pump, tubing, and flow through cell) using approximate length and inner diameter of pump tubing and volume of flow cell. After a minimum of one tubing volume has been purged, begin recording field parameter measurements (pH, SC, DO, water temperature, and, if indicated, turbidity and/or ORP) at three- to five-minute intervals. Water level measurements and pumping rate measurements (if varied) should also be recorded at this time. Note that the interval between field parameter measurements should allow sufficient time for the volume of water in the flow-through cell to be completely replaced by fresh groundwater, so modifications to the three- to five-minute rule of thumb may be necessary.

9. Stabilization criteria are based on three successive readings of field parameters that agree to within the stabilization criteria given in Table 1. Criteria for turbidity and ORP are included in Table 1, although these parameters are less frequently included as required field parameters for groundwater monitoring projects. The USGS does not consider ORP a "routine field measurement" due to difficulties associated with the accurate measurement and interpretation of the data. Note also that the USGS (2006) requires agreement over the course of five sequential measurements during "standard purge" measurements to indicate stabilization, rather than three. This SOP specifies stabilization over three successive measurements during low-flow purging and sampling as adequate for the majority of applications.

Table 1. Low-Flow Groundwater Sampling Field Parameter Stabilization Criteria

Parameter	Stabilization Criteria
pH	±0.1 pH units[3]
specific conductance	±3% (SC>100)[3] ±5% (SC<100)[2]
dissolved oxygen	±0.3 mg/L[3]
water temperature	±0.2°C[2]
turbidity	±10%[3]
ORP	±10 mV[1]

[1]Criteria from Yeskis and Zavala (2002).
[2]Criteria from USGS (2006).
[3]Identical criteria given in both Yeskis and Zavala (2002) and USGS (2006).

10. When stabilization criteria have been met, record final field parameter measurements and depth to water, and collect the groundwater sample. Maintain or slightly reduce the pumping rate for collection of samples, and collect the samples directly from the discharge port of the pump (i.e., do not collect samples after water has passed through the

field parameter flow through cell, inline flow meters, or other equipment). Rinse sample containers three times with sample water prior to filling (the rinsing step may be ignored if bottles are provided "pre-preserved," with preservatives already placed in the container). Sample containers should be filled by allowing water to gently flow down the inside of the container, minimizing turbulence.

11. If field-filtered samples are required, an in-line filter should be placed at the end of the pump discharge tubing. A small quantity of sample water (250 to 500 mL) should be allowed to pass through the filter prior to rinsing of sample bottles and collection of samples. Filters are single-use only; discard filters after collecting a sample and do not reuse.

12. Preserve groundwater samples as appropriate for the analysis required, tightly cap containers, and place in coolers with ice for storage and transport.

13. Shut off pump and complete sample documentation (field notebook and field sampling forms). For non-dedicated equipment, disconnect electrical and pump tubing connections, and decontaminate equipment as required by the project planning documents.

14. Close and lock well.

8.0 DATA AND RECORDS MANAGEMENT

Copies of all field notes and documentation collected during the low-flow purging and sampling procedure will be maintained in a project file (hard copies) and/or on the network directory dedicated to the project (electronic files). Field documentation should include notes regarding any difficulties encountered during implementation of the procedure, and any modifications to or deviations from this procedure or any other prescribed methods outlined in the project planning documents.

9.0 QUALITY CONTROL/QUALITY ASSURANCE

Quality control and quality assurance for low-flow groundwater sampling is similar to standard procedures for any type of water sampling, including adherence to methods stipulated in project planning documents, and collection and analysis of field quality control (QC) samples. Field QC sample types may include blanks (equipment rinsate blanks, trip blanks, bottle blanks, or other types), field duplicates, and standards (samples with known concentration) obtained from third-party vendors. The project sampling plan or quality assurance plan should be consulted to verify the frequency of field QC sample collection and to provide additional details concerning collection of these samples. In many cases, field blank and duplicate samples are collected at a frequency of 1 per 20 samples or 1 per day, whichever is more frequent.

10.0 REFERENCES

Yeskis, D. and B. Zavala, 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. Ground-Water Forum Issue Paper -- EPA 542-S-02-001. Office of Solid Waste and Emergency Response. May 2002.

USGS, 2006. Collection of Water Samples (v. 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapter A4, accessed 10/27/2010, from http://pubs.water.usgs.gov/twri9A.

Montana Department of Environmental Quality. Memo. SRS Low-Flow Purging and Sampling Guidelines, April 18, 2005.

Hydrometrics, Inc.
Consulting Scientists and Engineers

Project Name: IPC MNA Sampling
Project Code:
Sample Team Member(s):
Laboratory Used:

Site Designation:
Sample Code Number:
Sample Date:
Sample Time: (military)

If Duplicate Sample Collected, Please Record Below

Duplicate Sample Code #:
Duplicate Sample Time:

Site Conditions

New Site: Yes No Photo taken: Yes No

Site Type:
monitoring well domestic well seep
spring other:

Weather Conditions: calm breeze windy
no precip. rain snow
clear p. cloudy overcast

Air Temperature: °C °F

For Groundwater Samples

well volume formula: $V = \frac{(TD-SWL)x(Dia.^2)}{25}$ Comments

TD (ft):
SWL (ft):
Casing Diameter (I.D."):
Water Volume (V) (gal):
x 3=(gal.)
Actual Vol. Removed (gal.)
Water Level Recovery: slow moderate rapid

For Low Flow

Pumping Rate (Ml/Min): Cycles per min:
Fill (Sec): Discharge (sec):

purge pump and tubing prior to paramaters and sample

Field Parameter Stabilization

Time (military)	**ORP** (mV)	**DO** (mg/l)	**pH**	**S.C.** (µmhos/cm)	**Turbidity** (n.t.u.)	**Temp** (˚C)	**SWL**	**OTHER**	**ML**

Turbidity: (circle) clear moderate slight very

Sample Method: (describe) grab composite pump bailer other

Field Parameters

	Sample	Stabilization
ORP (mV)		± 10 mV
DO (mg/l)		± 0.3 mg/L
pH		± 0.1 pH unit
SC (µmhos/cm)		± 3% (SC>100)
Turbidity (ntu)		**F** > 10 NTU
H_2O Tmp. (°C)		± 0.2˚C
Color		
Other:	Turbidity taken at sample	

Bottles Collected

Quantity	Size	Filter or Unfilt.	Preservative	Parameter	Additional Notes

Comments:

Sample Team Member Signature: Page of

Field Parameter Stabilization

Time (military)	**Oxidation Reduction Potential** (mV)	**Dissolved Oxygen** (mg/l)	**pH**	**S.C.** (µmhos/cm)	**Turbidity** (n.t.u.)	**Temperature** (°C)	**Additional Parameters or Notes**

HSOP-106

FIELD MEASUREMENT OF pH, DISSOLVED OXYGEN, CONDUCTIVITY, ORP, AND TEMPERATURE USING A MULTI-METER

Prepared by: Josh Gilstrap **Date:** 4/12

Reviewed by: Mark Walker **Date:** 4/12

Approved by: Mike Wignot **Date:** 4/12

Hydrometrics, Inc.
3020 Bozeman Avenue
Helena, MT 59601

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1.0 SCOPE AND APPLICATION

This procedure will allow field personnel to collect pH, conductivity, dissolved oxygen (DO), temperature, and oxidation reduction potential (ORP) parameters of groundwater/surface water with a single meter.

2.0 SUMMARY OF METHOD

A multiple parameter meter (multi-meter) is calibrated and subsequently used to gather field water quality parameters for groundwater and surface water samples.

3.0 HEALTH AND SAFETY WARNINGS

Standards used for calibration of the multiple parameters of the meter may present a hazard to personnel performing calibration or handling solutions. Care should be taken to minimize the risks of spills. Minimum personal protective equipment (PPE) to be worn during calibration procedures should consist of latex or nitrile gloves. For calibration in the field at the project site rather than the lab, additional PPE may be required by the work plan or project specific Health and Safety plan. Material safety data sheets (MSDS) for all substances used for calibration should be available during calibration.

4.0 INTERFERENCES

The primary potential interference during use of the multi-meter comes from damage to the meter or its various probes. The meter should be handled with care to limit potential damage to the probes. Damaged probes should be repaired or replaced according to the manufacturer's instructions.

5.0 PERSONNEL QUALIFICATIONS

Personnel should be familiar with the usage and operation of the multi-meter being used. It is recommended that manufacturer's documentation on use and storage be reviewed prior to operation.

6.0 EQUIPMENT AND SUPPLIES

- YSI Model 556 Multi-meter (or similar);
- Standard/buffer solutions (Conductivity, pH, ORP)
- Latex or nitrile gloves;

7.0 PROCEDURE

7.1 CALIBRATION

7.1.1 Conductivity and pH

1. From the main menu, select **Calibrate**.
2. Place the correct amount of calibration standard into a clean, dry or pre-rinsed calibration cup.
3. Immerse the probe into the solution, making sure the sensor to be calibrated and the temperature probe are adequately covered.
4. Allow at least one minute for temperature to stabilize.
5. Select the sensor to be calibrated. For conductivity, a second menu will offer the option of calibrating in **specific conductance, conductivity,** or **salinity**. Calibration of any one option automatically calibrates the other two. For pH, a second menu will appear offering the choice of a 1-, 2-, or 3-point calibration. Always perform a 3-point calibration.
6. Enter the value of the standard being used. (For pH, always calibrate in the 7 buffer first.) Be certain that the units are correct and press **Enter**. The current values of all enabled sensors will appear.
7. Observe readings and when they show no significant change for approximately 30 seconds, press **Enter**. The screen will indicate if the calibration has been accepted.
8. Press **Enter** again to return to the Calibrate screen, or, for pH, to continue with the second point of the calibration.

7.1.2 Oxidation – Reduction Potential (ORP)

1. Place the correct amount of a solution with known ORP value into a clean, dry, or pre-rinsed calibration cup.
2. Immerse the probe into the solution, making sure the sensor to be calibrated and the temperature probe are adequately covered.
3. Allow at least one minute for temperature to stabilize.
4. Read the ORP value and compare to the known value. Note that ORP values vary with temperature.
5. If ORP value is within $\pm$20 mV of known value, record ORP value and temperature on calibration form.
6. If ORP value exceeds $\pm$20 mV of known value, selected Calibrate from main menu, select ORP sensor, and enter known ORP value.
7. Observe readings and when they show no significant change for approximately 30 seconds, press **Enter**. The screen will indicate if the calibration has been accepted.
8. Corrections of ORP to E_H are typically calculated for individual samples based on temperature, due to the variability of reference electrode potentials with changing temperature.

7.1.3 Dissolved Oxygen

1. Place approximately 3 mm (1/8 inch) of water in the bottom of the transport/calibration cup. Screw the transport/calibration cup onto the probe, engaging only 1 or 2 threads to ensure venting to the atmosphere. **Make sure the DO and temperature sensors are NOT immersed in water.**
2. Turn the instrument on to the Run mode and wait 10 minutes for the DO sensor to stabilize.
3. From the main menu, select **Calibrate**, then **Dissolved Oxygen**, then **DO%**.
4. Observe the readings and when they show no significant change for approximately 30 seconds, press **Enter**. The screen will indicate if the calibration has been accepted.
5. Press **Enter** again to return to the DO Calibration screen.

7.2 TAKING READINGS

1. Power the instrument on, or select **Run** from the Main Menu
2. Insert probe into the sample to be measured. Continuously move the probe through the sample until the readings on the screen stabilize. If using a flow through cell, insert and connect the probe to the flow through cell and wait until readings stabilize, according to HSOP-49.
3. Record the sample readings in the sample field book and on sample specific sample forms (if used).
4. If recording readings in the meter's electronic memory, use the arrow keys to highlight **Log one sample**, or select **Start logging** to record a series of data. Press **Enter**.
5. The Enter Information screen should appear. Use the keypad to enter a file name and description. Press Enter.
6. Highlight **OK** and press **Enter** to confirm the data was successfully logged.

8.0 DATA AND RECORDS MANAGEMENT

Field readings will be documented in the field notebook which is maintained in accordance with HSOP-31, and on sample specific sample forms (if used). Sample forms will be maintained in the project file as noted in HSOP-29.

9.0 QUALITY CONTROL/QUALITY ASSURANCE

Field personnel should cross reference recorded readings with the display on the meter. If at any time during the use of the meter erroneous readings are suspected, buffer solutions should be used to check calibration and recalibrate if necessary. Notes of the calibration check or calibration should be made in the field book. The project work plan and QAPP should be reviewed for project-specific directions regarding use of a multi-meter to gather and record water quality parameters.

10.0 REFERENCES

Hydrometrics' HSOP-29: Labeling and Documentation of Samples

Hydrometrics' HSOP-49: Use of a Flow Cell for Collecting Field Parameters

Appendix D – Waste Management Plan

HANDLING OF INVESTIGATION DERIVED WASTE

IDAHO POLE COMPANY SITE

IN SITU AMENDMENTS AND PERFORMANCE MONITORING IN SUPPORT OF FOCUSED FEASIBILITY STUDY

The primary waste streams to be generated during Component 1 and Component 2 activities include decontamination waters, well purge water, used personal protective equipment (PPE) and disposables such as paper towels and product packaging. The procedures for handling these materials are as follows:

- Direct push tooling used during Component 1 injections will be decontaminated using an Alconox and water solution or with a portable steam cleaner. Any water generated during decontamination procedures will be contained in portable decon pads situated near the drilling rigs. Deon water will then be transferred to 55 gallon drum. The label must state the source of material, location and date it was placed in the drum. The drum will be stored on the concrete pad within the secured fenced area near the former treatment building. The water will be sampled when the drum is full or at the end of Component 1 activities. The samples will be analyzed for PCP by Method 8241 by ARI Laboratory in Tukwilla, Washington. If samples exceed ROD cleanup levels, the water will be treated with Provect-OX®, sampled again and released to the ground if ROD cleanup levels are achieved. If soil residuals settle out prior to treatment, they will also be tested for PCP and treated with Provect-OX® if necessary, until ROD levels are achieved.

- Purge water generated during Component 1 and well monitoring and sampling of Component 2 will be disposed of on the ground.

- Used PPE and miscellaneous spent supplies and waste materials will be generated during sampling activities. The PPE and spent supplies will be cleansed of gross contamination if necessary (on decon pad) and placed in plastic garbage bags and held in the on-site dumpster for disposal at the local solid waste facility.

Appendix E – Laboratory Quality Management Plans

Analytical Resources, LLC. Quality Assurance Plan

Quality Assurance Plan

Analytical Resources, LLC
4611 S. 134th Place, Suite 100
Tukwila, WA 98168-3240

Revision 19.0
12/29/2021

Uncontrolled Copy
When Printed

This Quality Assurance Plan is approved and authorized for release by:

Mark Weidner, Laboratory Technical Director

Brian N. Bebee, Organic Analysis Section Technical Director

Casey English, Inorganic Analysis Section Technical Director

Bob Congleton, Quality Assurance Manager

Quality Assurance Plan

Analytical Resources, LLC

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SECTION 1: INTRODUCTION

Quality Assurance Policy and Objectives

Analytical Resources, LLC (ARLLC) strives to consistently provide accurate, reproducible and legally defensible data that meets its client's expectations. ARLLC's management has developed the policies and procedures described in this document to accomplish this goal and will provide the resources necessary to ensure that they are implemented in a timely, cost-effective manner.

This Laboratory Quality Assurance Plan (LQAP) has been prepared to conform to requirements of:

1. ISO/IEC 17025

2. TNI Standard 2009 particularly Volume 1, Modules 1,2 and 4

3. Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.3, 2019.

The principal tenet of the Quality Assurance Program at Analytical Resources, LLC. (ARLLC) is that every employee knows she/he is a vital component of the program, and holds a responsibility to produce high-quality, defensible, reproducible data in a timely manner. While production of quality data is a global philosophy held by the entire laboratory, each individual is responsible for ensuring that the data they produce meets the required quality objectives outlined in this LQAP.

Document sections detail policies on data ethics, data confidentiality, individual staff responsibilities, building security, laboratory operations including data validation and review, data storage, sample containers, sample receipt and custody, corrective actions and laboratory evaluations.

Appendices include specifically defined Quality Assurance Policies, including

1. Corrections to benchsheets
2. How to line out unused portions of benchsheets
3. Stop Work Orders

4. Annual SOP reviews
5. Standard format for describing dilutions
6. Standardized SOP formats
7. Manual adjustments of data
8. Performance Testing Samples
9. Modifications to analytical methods, procedures or reports
10. Reporting of data from dual column instruments
11. How to calculation uncertainty
12. Rounding of numbers and reporting limits
13. Use of the "J"-flag
14. Calculation of holding times
15. Subcontracting samples

1.2 Ethics Policy on Data Quality and Confidentiality

To ensure uncompromised data quality and client confidentiality, ARLLC has established the following corporate ethics policy. The policy applies to all ARLLC employees at every organizational level.

General

ARLLC's corporate commitment to integrity and honesty in the workplace is clearly stated in the ARLLC Employee's Handbook, under "Standards of Conduct" which is attached as Appendix H. The ARLLC commitment to excellence in data quality extends to and includes all aspects of data production, review and reporting.

Any attempt by management or any employee to compromise this commitment presents a case for serious disciplinary action. Any indications or allegations of waste, fraud or abuse will be rigorously investigated by ARLLC management, with the penalties for verified cases to be employment termination, and if appropriate, prosecution. In addition to these steps, any such charges related to data generated for the federal government will also be reported to the Inspector General of the appropriate department.

Circumstances

All ARLLC employees will immediately report to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any associated components).

Misrepresentation of data includes (but is not limited to) the following:

- *Altering an instrument, computer or clock to falsify time or output*
- *Altering the content of a logbook or data sheet in order to misrepresent data*
- *Falsifying analyst identity*
- *Changing documents with correction fluid with the intent of falsifying information*
- *Preparing or submitting counterfeit data packages or reports*
- *Unauthorized release (either written or verbal) of confidential data*
- *Illegal calibration techniques (peak shaving, fraudulent integrator parameters)*
- *Any attempt to misrepresent data or events as they actually occur in the course of data production or reporting*

Responsibilities

It is the responsibility of all ARLLC employees to report any situation which may be adverse to data quality or confidentiality, or which may impact the final data quality. All ARLLC employees have the obligation to discuss known or suspected violations of this policy with laboratory management, who in turn are obliged to inform the ARLLC's Laboratory Director. If a satisfactory resolution is not obtained or is not possible at laboratory level, all ARLLC employees have the right and responsibility to discuss the matter directly with the Laboratory Director.

It is the responsibility of ARLLC's Laboratory Director to promptly investigate any reports of known or suspected violations. The ARLLC Laboratory Manager has the authority and responsibility to resolve all known or potential violations of the policy.

It is the responsibility of ARLLC management to provide all of its employees with the facilities, equipment, and training to achieve the quality goals stated in the policy.

Documentation

To reaffirm an awareness of and commitment to the highest standards of data quality, excellence, and integrity, all employees are required to sign the following "Commitment to Excellence in Data Quality" statement:

> "As an ARLLC employee, I have the right and responsibility to report any situation which may adversely affect quality, or which may impact the final quality or integrity of data produced for our clients."
>
> "I will report immediately to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any of its as sociated components). Examples of this include (but are not limited to): alteration of an instrument computer or clock, alteration of the contents of logbooks and/or data sheets in order to misrepresent data, misrepresentation of analyst identity, intentional falsification of documents with correction fluid ("white-out"), preparation and submittal of counterfeit data packages, use of illegal calibration techniques (peak shaving, use of fraudulent integrator parameters, etc.), or any attempt to misrepresent data or events as they actually occur in the course of an analysis."
>
> "I will likewise alert management of any situation or activity which may be averse to the confidentiality of clients' data."
>
> "I will not knowingly participate in any such activity, nor fail to report such activities of which I may become aware. I understand that any voluntary participation on my part in such activities may result in the termination of my employment, and possible legal prosecution."
>
> "Where circumstances permit, I will report any actual or suspected violations of this policy to my lab or section supervisor. If a satisfactory resolution is not obtained or is not possible at that level, I have the right and obligation to discuss the matter directly with the ARLLC Laboratory Manager."

Confidentiality

All information related to client projects, such as client work plans, documentation and analytical data will be considered proprietary and confidential. This information will be released only to the client or an authorized representative. Should an outside agency request information related to a client project, the client will be contacted for approval prior to releasing any information.

Some programs or contractual agreements (such as the USEPA Contract Laboratory Program) may have specific requirements for protecting a client's confidentiality. Project Managers will be responsible for strict control of access to any such confidential information or documentation. All company computers with access to data are password-protected.

SECTION 2.0: QA MANAGEMENT AND RESPONSIBILITIES

2.1 Overall Structure

ARLLC's laboratory management includes the Laboratory Director Chief, the Chief Operations Officer, Laboratory Technical Directors, the Client Service Manager and the Quality Manager. Key administrative personnel such as Laboratory Supervisors, the IT Manager and Project Managers support the management structure. ARLLC's organizational structure is outlined in Appendix A. Section 2.2 outlines management's roles and responsibilities.

The Board of Directors shall direct ARLLC′s QA Policy and shall determine the philosophy of the QA Program. It shall be the responsibility of management to translate this policy into practical procedures with respect to the business plan developed for ARLLC, and direct laboratory personnel regarding the incorporation of these procedures into daily laboratory activities.

Management has overall responsibility for the technical operations and the authority needed to generate the required quality of laboratory operations. Management ensures communication within the organization to maintain an efficient and effective laboratory operation and to communicate the importance of meeting customer, statutory, and regulatory requirements. Management ensures that the system documentation is known and available so that appropriate personnel aware of their responsibilities. When changes to the management system occur or are planned, management ensures that the integrity of the system is maintained.

Management is responsible for carrying out testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and that meet the needs of the client.

2.2 Hierarchical Responsibilities

Laboratory Director

The Laboratory Director shall interpret overall QA Policy based on the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and determine the broad practicality of policies based on methodologies, technological advances, and the current environmental market. It shall be the interpretation of these policies that will, in turn, direct the growth ARLLC, the addition or withdrawal of methods to ARLLC′s repertoire, and ARLLC′s marketing focus.

At a minimum of once a year, usually at the end of year summary, the Laboratory Director shall include on the agenda of the Board of Directors meeting a discussion of ARLLC′s QA Policy. This discussion will include the reputation of ARLLC for producing quality analyses, the effect of QA policies on turn-around time, competitive edge and cost-of-analysis, needs for stricter or more flexible policies, and the response of employees to the QA policies in place at that time.

At a minimum of once every quarter the Laboratory Director or Chief Operating Officer shall attend management meetings, which include on the agenda the subject 'QA Program'. This meeting will be included in the Steering Committee meeting schedule, which is held on a biweekly basis, and the last meeting of each quarter (calendar year) will include the quarterly QA report as the focus. The schedule and topics for Steering Committee meetings will be set at the beginning of each year and distributed to the members through calendar invitation. This format will allow for the dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors. Management shall also use these meetings to discuss requirements of clients that are not met by ARLLC′s present QA Program, and the appropriate response to these requirements.

The Laboratory Director may be required to act as a technical advisor at any impromptu meetings called by management to address QA issues that cannot be immediately resolved within a laboratory section.

It shall also be the Laboratory Director's authority and responsibility to hold final review approval for all SOPs of ARLLC. Once an SOP has been updated and reviewed by the laboratory section, it shall go through the Section and Laboratory Managers for approval, and then to the LTD for final approval before the SOP is released.

The Technical Director of the Organics Division is the deputy Laboratory Technical Director. Whenever the Laboratory Director is absent for 15 or more consecutive days the Technical Director - Organics Division will temporarily assume her/his duties.

ARLLC’s primary accreditation bodies will be notified when the Laboratory Director will be absent for 35 consecutive days.

Chief Operating Officer

The Chief Operating Officer is responsible to coordinate Client Services and Information Technology activities to result in an integrated approach to quality data production. It shall be the Chief Operating Officer's responsibility to coordinate Client Services, Laboratory Management, and Information Technology Services, to ensure that QA Program requirements and data quality objectives are met.

The Chief Operating Officer plans and initiates periodic management meetings, at which the QA Program will be an agenda item. Management shall use these meetings to discuss requirements of clients that are not met by ARLLC′s present QA Program, the appropriate response to these requirements, and dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors. The management meeting schedule is detailed under the Steering Committee definition. The Chief Operating Officer or designee is responsible for recording the minutes of the meeting.

It is the responsibility of the Chief Operating Officer, along with the QA Manager, Laboratory Director, Section Managers and Client Services, to establish testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and that meet the needs of the client.

The Chief Operating Officer has the authority to direct Client Services to discontinue the bidding/contracting process for a new project, refuse samples, or to re-schedule projects based on Data Quality Objectives or current workload. The Chief Operating Officer also shall evaluate staffing and equipment needs based on information from the Section Managers and Client Services and may elect to meet new project requirements by increasing staffing levels or purchasing additional equipment.

The Chief Operating Officer serves as a senior-level technical reference for all laboratory activities, and as such will be brought in to advise on out-of-control events and trends, corrective actions, and/or other QA issues that require his/her expertise.

ARLLC’s Client Services Manager is the deputy Chief Operating Officer and will assume the Chief Operating Officer duties whenever the Chief Operating Officer is absent for more than seven consecutive days.

Laboratory Technical Directors- Organic Division and Inorganic Division

Laboratory Technical Directors shall have the final authority in decisions concerning implementation of QA policy in their laboratory sections. It is their expertise that will determine if testing activities meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and the needs of the client.

Laboratory Technical Directors are responsible for correcting out of control events within their respective laboratories. Laboratory Technical Directors and supervisors shall instruct employees in the proper employment of QA Policies.

Laboratory Technical Directors are responsible for completing or delegating updates of laboratory procedures and quality assurance manual sections as scheduled by the QA Manager. They will review and approve all laboratory Standard Operation Procedures.

The Laboratory Technical Directors are best able to determine capacity of the Laboratory Sections. To ensure that analyses are completed within required hold times, the Laboratory Technical Directors will give Supervisors the authority to balance employee workloads and modify employee work schedules. It is the Laboratory Technical Directors' responsibility to take reports from supervisors and work with the Laboratory Director to increase staffing levels or reject samples as needed. It is the Laboratory Technical Directors' responsibility to work with the Laboratory Director and section supervisors and analysts to ensure that sample capacity does not affect the quality of data generated from that laboratory section.

It is the responsibility of the Laboratory Technical Directors, along with the QA Manager, Laboratory Director, Chief Operating Officer, and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate, and which accreditation processes ARLLC will pursue. It is the responsibility of the Laboratory Technical Directors, with the Section Supervisors, to ensure that all laboratory sections perform the tasks required by the QA Manager to pursue each accreditation or to complete a scheduled audit.

The Laboratory Technical Directors will be responsible for reviewing training records of analysts produced by the Section Supervisor. Training shall be the responsibility of the Section Supervisor, but it is the responsibility of the Laboratory Technical Directors to oversee this training.

It is the Laboratory Technical Directors' responsibility to work with the Section Supervisor and Project Manager to ensure that Project Requirements are achievable and valid for the given methods. At times, ARLLC's clients have requests or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently performed by the laboratory, or 3) unachievable by the instrumentation used in the laboratory. It is the responsibility of the Laboratory Technical Directors, Section Supervisors and Project Manager to work with the client to resolve these issues before samples are accepted.

Clients may also request modifications to the methods that must be approved by the Section Supervisor, the Section Manager and the Quality Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and information technology (computer services), as needed for implementation.

The Laboratory Technical Directors are responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts or Section Supervisor.

The Laboratory Technical Directors have the authority to re-classify analysts or require additional training of analysts based on their performance.

The Laboratory Technical Directors have the responsibility of balancing client requests and requirements with the QA policies of ARLLC. It is the Laboratory Technical Directors' task to evaluate a client's Data Quality Objectives (submitted through Client Services), and with the Project Managers, Laboratory Supervisors and Quality Manager to determine the feasibility of laboratory performance. Feasibility will be based on the quality objectives requested, current QA Manual, present workload (in-house and scheduled/pending), the technology in place, and staffing levels available. Current workload in-house will be evaluated using reports from Information Technology, and scheduled/pending workload will be evaluated using written and verbal input from Client Services.

Deputies for the Organics and Inorganics Technical Directors are the Organics Extraction Laboratory Supervisor and the Metals Instrument Laboratory Supervisor respectively.

Laboratory Supervisor

To ensure that analyses are completed within required hold times, the Laboratory Supervisors have the authority to balance employee workloads and modify employee work schedules. The Laboratory Supervisors, with the input of the Laboratory Technical Director, have the authority to request overtime from employees should the workload warrant the additional effort, or to modify employee schedules to extend the operating hours of the laboratory section.

The Laboratory Supervisors shall oversee the day-to-day section operations, using LIMS printouts and verbal or written workload estimates and requests from Project Managers to adjust section efforts as needed. It is also the Laboratory Supervisors responsibility to inform management, when capacities are limited, so that the appropriate adjustments can be made to reduce workloads or increase laboratory capacities. At no time should sample capacity be allowed to affect the quality of data generated from any laboratory section.

It is the Laboratory Supervisors responsibility to ensure that employees have the proper training for their positions. This training will include training in the methods, use of the LIMS system if applicable, training in correct documentation procedures, and all information necessary for adherence to the ARLLC QA Program. The Laboratory Supervisors shall either perform the training personally or designate the trainer for given methods or procedures. It is the Laboratory Supervisor's responsibility to test each employee for each method or procedure, and to thoroughly document each employee's advances and current capabilities. The Laboratory Supervisors shall have the authority to require further training or supervision for any employee and shall be the authority to approve each employee for working without supervision. All employee training records are maintained in the SharePoint *Employee Records* library.

It is the Laboratory Supervisors responsibility to work with the Laboratory Technical Director and Project Manager to ensure that project requirements are achievable and valid for the given methods. At times clients have requests and/or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently part of the method as performed by the laboratory, or 3) unachievable by the instruments used in the laboratory. It is the responsibility of the Laboratory Supervisors, Laboratory Technical Director and Project Manager to work with the client to resolve these issues before samples are accepted.

It is the responsibility of the Laboratory Supervisors to ensure that each analyst reads and understands all requirements submitted with each sample set, including those for any special analyte, calibration, or data deliverable. It is the Laboratory Supervisors responsibility to clarify any issues, with the input of the Laboratory Technical Director and the Project Manager for the client.

Clients also at times will request modifications to methods, which must be approved by the Laboratory Supervisors and Laboratory Technical Director. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and IT personnel (computer services) as needed for implementation.

It is the Laboratory Supervisors responsibility to ensure that each employee understands the requirements of all projects they work with. This may necessitate section meetings or project-specific cross-section teams to work with Project Managers for large, specialty projects to ensure that everyone has the same understanding of project requirements.

The Laboratory Supervisors is responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts, and for ensuring that the analysts complete all documentation. If the Laboratory Supervisors and laboratory section analysts cannot resolve the issues in a timely manner, the Laboratory Supervisors will request the assistance of laboratory management to bring the section into compliance. The Laboratory Supervisors will also inform Project Management and his/her Laboratory Technical Director of possible delays in the analytical process.

The Laboratory Supervisors shall have the authority, usually in consultation with Laboratory Technical Director or Project Management to use professional judgment in requiring samples be re-prepared and shall determine which analysts have the authority to require re-preparation of samples.

It is the responsibility of the Laboratory Supervisors to inform the Quality Manager, Laboratory Technical Director and Information Technology personnel of any changes in methodologies that will require revision of SOPs, MDLs, Control Limits or the LIMS programming. This includes changes in spiking compounds, spiking levels, preparation methods and analytical methods.

Analysts

Analysts are responsible for following the current SOPs (with project-specific modifications if required) in preparing and analyzing client samples and quality control samples to meet the project specific Data Quality Objectives. It is the analyst's responsibility to ensure that he/she understands all requirements of a project before proceeding with sample preparation or analysis.

Analysts are responsible for working with the Laboratory Supervisors to ensure that all sample preparations and analyses are performed within required holding times and required turn-around times, and that all documentation is completed in a timely fashion. It is each analyst's responsibility to bring any recurrent or anticipated problems to the attention of laboratory management.

It is each analyst's responsibility to correct his/her own errors, to document corrective actions thoroughly, to perform peer review, and to ensure that fellow employees within the section follow documentation procedures.

Laboratory Supervisors may give lead analysts responsibility for training and evaluation of new staff members. This training will include instruction in the methods, use of the LIMS system if applicable, correct documentation procedures, and all information necessary for adherence to the QA Program. Analysts will be responsible for maintaining all instruments and equipment in optimum operating condition and documenting this maintenance as required by the QA Program.

It is the responsibility of each analyst to request the assistance of Laboratory Supervisors or other managers in resolving out-of-control situations that cannot be corrected in a timely manner, and to perform the documentation of all corrective action activities.

Quality Manager

The Quality Manager is responsible for the oversight of the QA Program as defined by the Board of Directors and interpreted by the Laboratory Technical Director, the Chief Operations Officer and Laboratory Technical Directors.

The Quality Manager is responsible for maintaining all required outside accreditation and will coordinate with appropriate accrediting bodies

Part of this oversight will be monitoring of the QA Program through submission of performance testing (PT) samples, blind QA samples and double-blind QA samples. The Quality Manager will be responsible for submitting these samples to the laboratory for analysis, overseeing submission of the results to the appropriate agencies.

Internal assessments of ARLLC's Quality System will examine all phases of laboratory operation annually. External assessments are scheduled by ARLLC's accrediting bodies.

The Quality Manager is responsible for scheduling an annual review of ARLLC's laboratory Quality Assurance Manual (LQAP) and all SOPs. The Steering Committee members will be reminded of the need for the review in the first month of each calendar year and will have until the end of the first quarter to complete their reviews. The Quality Manager will review and oversee maintenance of bench sheets, logbooks, control charts, MDL studies, MDL/LOD verifications and any other quality related documents.

The Quality Manager is responsible for oversight of the Corrective Action database, an application for recording and tracking progress of corrective actions. The Quality Manager will assign tasks to laboratory or IT personnel for resolution of quality issues in a timely manner and will review each resolution before closing an issue.

The Quality Manager is responsible for evaluation of the laboratories' adherence to defined protocols through periodic audits of completed projects and of the laboratory facilities. System audits will take place quarterly (calendar year) according to the "Quarterly QA Tasks" list (See: Appendix I) and results will be documented in the SharePoint/ARI QA/Internal Audits library. There will be an annual audit of Test Methods and non-technical systems following the "ARLLC Annual Test Methods and non-Technical Audit Schedule" (See: Appendix I which includes audits of technologies such as lachat, pesticides, hydrocarbons, as well as subcontract accreditations, services to the clients, recommendations for improvement and complaints.

The Quality Manager will be responsible for evaluation of outside accreditation requested by Client Services. The QA Manager will deliberate with other management personnel on the feasibility of pursuing accreditation based on the scope of the accreditation, the effort required to pursue accreditation and the scope of work that might become available once the accreditation

is obtained. If a decision is made to pursue an accreditation, it is the responsibility of the Quality Manager to coordinate laboratory efforts towards the accreditation.

The Quality Manager will serve as a resource for quality-related issues for all Laboratory Sections and will serve management in an advisory capacity.

The Quality Manager will plan, implement and maintain ARLLC's technical training program.

The Quality Manager will maintain the minutes of the Steering Committee taken by the Chief Operating Officer.

The Quality Manager will have documented training in elementary statistics and Quality Systems theory.

Information Technology

ARLLC currently operates two tiers of hardware systems, a legacy system for instrument support of older instruments, and a modern tier for end users (project managers, data processing, accounting, sample receiving and new instrumentation and main servers). Information Technology (IT) personnel are responsible for ensuring that computer hardware and software meet the requirements of the company.

Servers are purchased and installed with the support of approved third-party providers who consult on project requirements (backup servers, mirroring, security, access) and required no further validation of hardware or software installed after sign-off with the vendor. Hardware and software associated with instrument control and data acquisition for new instruments and provided by an approved vendor are presumed to be vetted by that vendor and are accepted as provided.

IT personnel are responsible for formatting replacements for legacy tier workstations that are used to host instruments that are not compatible with modern software. These replacements are formatted from scratch with a new hard drive by IT personnel and are tested based on the application needs of the instrument, sometime requiring a separate network for instrument control. The workstations are signed off once the analyst can establish communication with the instrument and any ancillary equipment (i.e., autosampler), process any acquired data using the instrument specific application, and move the data through to Element LIMS for reporting.

The modern tier computer systems will be purchased only from approved vendors. IT personnel are responsible for assuring these systems are loaded with a clean operating system (currently Windows 10) and core applications (Acrobat Reader, Excel, Word, etc.) approved by IT personnel, the Laboratory Director and/or the Technical Directors. Systems must have a minimum of a Core i5 processor and 8GB RAM. Once core applications have been loaded, IT personnel are responsible for joining the device to the local domain. All the applications are checked for proper configuration by IT personnel before moving into production.

IT personnel are responsible for staying informed on improvements in the computer industry that can be advantageous to the Company in terms of increased efficiency or security. Laboratory managers and supervisors are responsible for requesting upgrades or replacements of legacy computer equipment as needed. The Laboratory Director with the Chief Operating Officer and Laboratory Technical Directors (Managers) are responsible for approving purchases.

Updates to the current LIMS system are assumed to be tested by the vendor and ARLLC IT personal review published revision notes prior to distribution. Before updates are installed, IT personnel are responsible for creating an additional backup of each program section, and alerting users that an update has been rolled out. Users are responsible for notifying IT personnel through the Helpdesk when issues occur, if a 'roll back' to a working version is required. If a rollback is required, it is the responsibility of IT personnel to investigate the issue with the update and contact the vendor for resolution if required.

Information Technology personnel are responsible for ensuring that the LIMS correctly reflects the preparations and analyses performed and that the LIMS is updated to include the current SOP, MDL, RL and QL data, as submitted by the QA Manager. Information Technology personnel are also responsible for ensuring that all electronic deliverables for clients are formatted correctly as requested by the Project Managers and that electronic data matches the hardcopy deliverables submitted.

Staff assigned as 'data reviewers' (the Laboratory Director, the Technical Directors and/or the Laboratory Supervisors) are responsible for a secondary check on calculations for newly created analyses, including correct MDL, RL and QL values, preparation volumes and cleanups and final calculated results. This check may include comparison to calibration values generated by

instrument data systems, comparison to QA summary lists, or comparison of data system final results to hand calculated final results.

It is the responsibility of the Information Technology Manager to update, or to designate the task of updating, the LIMS as determined by Laboratory Management, including adjustment to current MDL/RL data, additions of analytes to methods, changes in method designations or changes in calculations for methodologies.

Information Technology will be responsible for generating the work list scripts required to allow analysts to enter data into the LIMS, and for generating the report scripts that produce final hardcopy or electronic reports for clients.

Information Technology Management and personnel are also responsible for generation and review of electronic data deliverables (EDD), as requested by clients through Project Management. Information Technology personnel will review the EDD for compliance with the Software Quality Assurance SOP #101S before the data is released to the client.

Information Technology will be responsible for informing laboratory Section Managers and Project Managers of any discrepancies found between the EDD and the hardcopy, and for following up on corrections to hardcopy and EDD as required.

Information Technology will be responsible for sending out the calendar invitations for the Steering Committee and noting the meeting focus, based on the format set by the Chief Operating Officer, and for recording any video meetings of the Steering Committee.

ARLLC's Chief Operating Officer is the deputy Information Technology Manager. When the Information Technology Manager is absent the Chief Operating Officer perform Information Technology duties.

Client Services

Client Services (CS) (Project Managers, Sample Receiving, and Sales Management) personnel are the primary interface between ARLLC′s clients and the laboratory sections. CS staff shall be responsible, with the assistance of the Section Managers and Supervisors, for ensuring that the laboratories understand and can meet the Data Quality Goals and Requirements of each

Project before committing laboratory services to the project. CS will monitor the quality of sample processing after they are received.

Client Services Management and Project Managers shall ensure that the laboratories can meet the data quality objectives for a project. The Project Managers are responsible for knowing the capabilities of the laboratory, in order to develop project proposals or accept samples without consultation with laboratory management. It is the responsibility of Client Services to consult with the Laboratory Manager and Section Managers, or supervisors designated by Management, when data quality goals are not included in standard Company policies. Clients may, at times, request modifications to methods that must be approved by the Supervisor and Section Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and IT personnel as needed for verification of feasibility. Laboratory Management may determine that a project should not be pursued based on the specific Data Quality Objectives and on current or projected laboratory capacity.

Project Managers shall be responsible for ensuring that project requirements and analytical requests are submitted correctly to all laboratory sections. Once samples have been logged into the laboratory, it is the responsibility of the Project Managers to ensure that all information is available to the laboratories concerning the Data Quality Objectives and deliverables requirements. It is also the responsibility of the Project Managers to convey changes in client requirements to the laboratories and ensure that all paperwork reflects the changes if necessary.

It is the responsibility of Project Managers and Client Services Management to ensure that specific EDD formats are submitted to IT personnel and approved as feasible before contracting with a client to provide the EDD.

It is the responsibility of Project Managers to notify clients of out-of-control events, “problem” samples, or anticipated turn-around time delays, as conveyed to them by Laboratory Management. It is also the responsibility of Project Management to work with Laboratory Management in setting priorities during times of heavy sample workloads.

Project Managers shall be responsible for coordinating data submissions and compiling hardcopy data for final submission to the client. This involves conducting a fourth level data

review, from which any data which is found to contain errors that were not found earlier in the review process is returned to the Data Reviewer for correction and/or corrective action. Quality errors (other than a typo or data entry error) should be recorded in the Corrective Action database for tracking purposes. The Project Manager will be responsible for compiling all analyst notes into a project narrative. This will include discussion of any sample receipt discrepancies, sample preparation and analysis difficulties or non-compliance, and any corrective actions that may have been required during processing. It will also discuss quality control analyses and results if applicable to the sample set.

Project Managers shall work with Laboratory Management in determination of the direction of growth for ARLLC, as the Project Managers are best able to define the analytical needs of clients based on new technologies and new environmental regulations.

ARLLC's Chief Operating Officer is the deputy Client Services Manager. When the Client Services Manager is absent the Chief Operating Officer perform Client Services Manager duties.

Steering Committee

A group consisting of the above listed managers, supervisors as well as some lead analysts, that meet on a biweekly basis on Tuesdays to discuss incoming work, quality improvement issues, staffing and training improvements, equipment and supply issues, changes in analyses, and to review section reports. There will be no meeting on weeks with Holidays, and no more than four meetings per month. The chair for each meeting will rotate depending on the focus.

The Chief Operating Officer will set the focus of each meeting. Currently the focus of the first meeting each month will be Incoming Samples, the second meeting each month will be budget oriented, the third meeting each month will be centered on Laboratory Operations. The focus of the last meeting each month through a quarter will be Marketing and Sales (first month), Client complaints and accolades (second month) and QA Report and Quality Improvements (third month). Any or all of these topics may be covered in any weekly meeting based on need.

SECTION 3: PERSONNEL QUALIFICATIONS AND TRAINING

The production of quality analytical data is dependent upon a laboratory staff with qualifications and training necessary to perform assigned tasks. All personnel employed by ARLLC will receive adequate training and instruction specific to their responsibilities. Prior to assigning a staff member full responsibility for performing a laboratory procedure, her/his skills are evaluated and verified acceptable. It is the obligation of ARLLC′s supervisors and managers to ensure that personnel are qualified to successfully perform all assigned duties.

ARLLC′s training program is described in SOP 1017S (*Training and Demonstration of Proficiency*). The procedures described in the SOP ensure that all ARLLC employees are proficient at the tasks required to produce quality analytical data. The SOP also provides for periodic review of each employees training and proficiency status, which may indicate any need for additional or remedial training. All training and review procedures are documented as described in the SOP.

Basic elements of ARLLC′s training program are:

1. All employees are required to read and document their knowledge of non-technical documents that describe general policies in place at ARLLC including ARLLC′s *Employee Manual* and ARLLC′s *Chemical Hygiene Plan*.
2. All technical employees are required to read and document their knowledge of ARLLC′s *Laboratory Quality Assurance Plan* and quality assurance policies.
3. All new employees must attend a Quality Assurance Orientation during which ARLLC′s general and specific requirements for the production of quality analytical data are introduced.
4. All new technical employees will attend a laboratory specific technical orientation conducted by their laboratory supervisor or manager that provides specific information about laboratory operation.
5. All employees will complete an ‘on the job’ training program designated by their supervisor. The training program will be laboratory, SOP and employee specific. The training is incremental with each step documented in an employee Training File. While an analyst is in the training period, her/his supervisor or trainer must approve all their `analytical work.

6. Upon completion of the training program a technical employee must complete an Initial Demonstration of Capability (IDOC) as described in ARLLC SOP 1017S. An analyst is considered proficient and may perform analytical procedures without supervision only after they have completed training and a successful IDOC.
7. The proficiency of each employee performing a given laboratory SOP is continually monitored and documented as described SOP 1017S. To maintain proficiency, an employee must continually generate data that meets all of ARLLC's published acceptance criteria for a given SOP. Unacceptable results or insufficient number of analyses performed in a calendar quarter will result in revocation of proficiency. This will result in a remedial training program.
8. Each analyst is responsible for maintaining a training record as described in SOP 1017S. The training record will document an employee's experience, training and capability. The training file will be maintained in ARLLC's "cloud" based Microsoft SharePoint™

SECTION 4: FACILITIES AND EQUIPMENT

4.1 Facilities

ARLLC′s physical facilities allow for efficient sample processing and analysis while maintaining consideration for the health and safety of the staff. The facility accommodates the following operations:

Sample receipt and storage
Sample container preparation and shipment
Sample preparation and analysis (organic and inorganic)
Project planning and management
Quality assurance
Data review and report generation
Computer programming and operations
Records storage
Instrument spare parts storage
Frozen sample archive
Short-term hazardous waste storage

A detailed description of ARLLC′s facilities is included as Appendix C.

4.2 Security

Facilities

To ensure sample and process security, access to ARLLC's facilities is limited to employees and escorted visitors. All outside entrances are locked and/or continuously monitored. Visitors must register at the reception desk, be escorted while in the laboratory and sign out prior to leaving. Key access to the facility is controlled; keys are issued only on a limited "as needed" basis.

Because of the strictly controlled access and a 24-hour monitored alarm system, ARLLC considers the entire facility is a secure area. This eliminates the need for locked sample and data storage within the building.

Data Access

ARLLC's Information Technology (IT) Manager controls security of, and access to, electronic data on all data systems. ARLLC's IT team has implemented processes and procedures to ensure data integrity and prevent intentional intrusion by outside parties. These measures are robust but not so restrictive that they prevent data accessibility. These measures include

building security, limited computer system access, password systems, two-step authentication for remote or mobile systems, encryption, firewalls and the use of virus protection programs. ARLLC′s Intranet is protected from outside tampering by a proxy server (firewall) connection to the Internet.

LIMS - System Security

Building/Computer Room Security

Access to the building is restricted to employees, vendors with security passes, and escorted visitors. Room 203 contains the computer and main console for the LIMS system. This room is closed and locked at all times. Access to this room is limited to IT personnel, escorted repair technicians, and escorted visitors. Only IT personnel will be allowed access to the main console.

System Password Policy

Username and password restrict access to the LIMS computer. Remote access to the LIMS server is not allowed.

Database Access Restrictions

Interaction with the database is menu-controlled and allows the LIMS Manager to restrict access. Technicians may be given the ability to fill a limited number of work lists, with no authorization to distribute data. Some users may be given “read only” access to the database.

Users will be given access to the database only to complete tasks for those analyses for which they are responsible. No users are to be given access to the shell or command prompt unless 1) they have completed the appropriate training and 2) administrative access to the computer systems is required by their job function

4.3 Safety

The safety and well-being of staff is imperative. ARLLC’s facilities are designed and equipped to minimize personnel exposure to hazardous substances or situations. The Chemical Hygiene Plan details safety procedures and requirements that ARLLC staff must follow. An active safety committee meets monthly to review the safety activities of all laboratory sections and to ensure that all operations and equipment meet safety criteria. *The Chemical Hygiene Plan* is reviewed annually and updated as needed to incorporate any changes to ARLLC′s safety program.

4.4 Instrumentation and Support Equipment

4.4.1 Instrumentation

Generation of quality data is dependent upon instrumentation and support equipment that is in optimum operating condition. All instrumentation and support equipment will be optimally maintained following method requirements and/or manufacturer's recommendations. Preventative maintenance is performed on a scheduled basis, with more frequent maintenance during periods of increased sample load or after analysis of highly contaminated samples. All instrument maintenance is documented in Element LIMS. When non-routine maintenance is required, the following information must be recorded:

1. A statement of the problem or symptom that requires correction.
2. Details of the maintenance procedure including listing the parts repaired or replaced.
3. Documentation that the instrument has returned to routine performance.

ARLLC maintains an inventory of all instruments and other additional pieces of equipment such as sample trays, auto-sampler towers, and concentrators within Element LIMS' *static table.* Each piece of equipment is tracked via its serial number (or another unique ID) within the static table to facilitate historical reconstruction of any analytical event.

ARLLC also maintains a physical inventory of spare parts, and/or orders parts on an expedited basis, to minimize downtime.

Appendix D is a current list of laboratory instrumentation and equipment.

4.4.2 Support Equipment

4.4.2.1 Thermometers in use at ARLLC are traceable to an NIST standard and calibrated or verified as described in SOP 1020S. Electronic thermometers are verified quarterly and liquid in glass thermometers annually. When appropriate, thermometers are assigned a correction factor based upon the most recent calibration. ARLLC personnel must calculate and record corrected temperatures based on the correction factor.

4.4.2.2 Water Bath temperatures are recorded before each use to ensure the temperature is acceptable for its intended use.

4.4.2.3 Incubator temperatures (corrected) are recorded at least twice a day while in use. The date and time for each observation is recorded.

4.4.2.4 Oven temperatures are recorded at the beginning and end of each workday they are in-use.

4.4.2.4 Refrigerator and Freezer temperatures are recorded automatically every 30 minutes by ARLLC's electronic "ThermoLogger". QA staff are notified via e-mail when a recorded temperature is out of compliance. "Thermologger" temperature probes are verified / calibrated quarterly.

4.4.2.4 Balance accuracy is verified daily prior to use with two Class S weights that bracket the normal weighting range of the balance. A balance must be accurate to ±0.1% or ±0.5 mg whichever is greater. All analytical balances are professionally cleaned and calibrated annually by an outside contractor. Class S weights are calibrated every five years by an outside contractor.

4.4.2.5 pH Meters are standardized prior to each use with at least two standard buffers, one at 4.0 and one at 7.0 pH units.

4.4.2.6 The accuracy of Variable Volume Pipettes and Mechanical Burettes is routinely verified on a daily, weekly or monthly basis as described in ARLLC's SOP 1015S.

4.4.2.8 Sample Containers: – ARLLC supplies clients with containers for the collection of field samples. All containers supplied for organic and trace metals analyses are pre-cleaned and certified by the manufacturer. When the manufacturer's certified concentration is greater than ARLLC's reporting limit for a specific project, a container is used to prepare a method (bottle) blank. ARLLC certifies that the containers from the same lot are suitable for sample collection when target analytes are not detected in the bottle blank. Containers for conventional analyses are not pre-cleaned and are certified internally by ARLLC following the procedures in Appendix 12.3 of ARLLC SOP 001S (Sample Receiving).

Container lot numbers are recorded when containers are sent to a client.

4.4.3 Chemical Standards and Reagents

4.4.3.1 Reagent Water Supply

ARLLC maintains a centralized water purification system. The quality of the water produced is monitored and documented daily in a bound logbook. All reagent / de-ionized water used within the laboratory must meet or exceed ASTM Type II Standards. In addition, water used in the Volatile Organic Laboratory is filtered through activated charcoal to ensure it does not contain organic compounds.

4.4.3.2 Chemical Standards

Most standards used to determine the concentration of target analytes are purchased as certified solutions. These standards are traceable to a National Institute of Standards & Technology (NIST) standards and documented with a Certificate of Analysis. In addition, all quantitative standards (traceable, non-traceable and those prepared by ARLLC) are verified by comparison to a second standard reference material obtained from an alternate source. The source, date of receipt, required storage conditions and an expiration date for all standards are recorded in ARLLC's Element LIMS system. SOP 1013S *"Purchasing and Documentation of Supplies Equipment and Services"* outlines procedures for receiving, preparation and storage of analytical standards

4.4.3.3 Chemical Reagents

Many of the analytical processes in use at ARLLC require chemical reagents not directly used in the calibration process. These reagents provide for analyte preservation, adjustment of pH, formation of colorimetric indicators, etc. All reagents are purchased in a grade and purity sufficient for their intended use. All reagents and accompanying Certificates of Analysis are documented in Element LIMS. Each original reagent container is labeled with the date it is opened and an expiration date as appropriate.

Solutions prepared from reagents are recorded in the LIMS system. Reagent containers are labeled with Reagent Number, date of preparation, expiration date, and preparer's identification.

Procedures for Reagent Receiving and Preparation are detailed in SOP 1024S.

Trace Metals Acids

To ensure the quality of acids, nitric and hydrochloric, used for trace metals analyses, ARLLC purchases only the highest quality, certified "metals free" acids. Each lot received is analyzed for purity prior to use to ensure that it is acceptable. When possible, an entire lot of acid will be reserved for use exclusively by ARLLC. This minimizes the possibility of receiving contaminated or unacceptable acid.

Solvents

To ensure the quality of solvents used for sample preparation and analysis, ARLLC uses only the highest purity solvents available. A portion of each lot of solvent received is analyzed to verify its stated purity. Only solvent lots determined acceptable will be used for sample processing. Whenever possible, entire solvent lots will be reserved for use. This minimizes the possibility of receiving contaminated or unacceptable solvents.

Compressed and Cryogenic Gases

To reduce the possibility of system contamination, compressed and cryogenic gases used for operating analytical instrumentation will be of a specified purity level. A cylinder suspected of introducing contamination into a system is immediately replaced.

4.5 Computer Systems

ARLLC maintains several distinct and separate data systems. These are used to automate such diverse functions as accounting, payroll, sales and marketing, sample receiving, instrument data collection, production of hardcopy and electronic data deliverables, intra- and internet applications and project management. Specific information about these systems is contained in Appendix D and various SOPs.

ARLLC maintains a Laboratory Information Management System (LIMS) that stores analytical data, calculates final results and produces final reports (both hardcopy and electronic). The LIMS system is the major data system used at ARLLC.

SECTION 5: LABORATORY DOCUMENTATION AND RECORDS

All laboratory operations and procedures performed during sample receipt, processing and reporting are thoroughly documented in electronic or handwritten records. These records are objective evidence of the work performed and are detailed enough to allow recreation of all procedures performed by the laboratory.

All routine procedures performed at ARLLC are documented in Standard Operating Procedures (SOPs). Electronic, controlled copies of all SOPs are maintained in ARLLC's "cloud" based Microsoft SharePoint™ file system. SOPs are reviewed and/or edited annually or when processes or procedures change.

If ARLLC is sold or transferred to a different ownership group, all records will be handled as specified in client contracts. In the absence of contractual requirements, records will be transferred to the new owner(s) as specified in the purchase/sale agreement."

5.1 Responsibilities

All staff members are responsible for complete and accurate documentation of laboratory activities. Each laboratory section employs a comprehensive set of documents (bench sheets, forms, etc.) to record all activities performed in that section. All staff members are responsible for reviewing and documenting their understanding of appropriate SOPs. ARLLC's QA Manager is responsible for maintaining control of laboratory documents and ensuring their consistent use.

To ensure that all documents including SOPs accurately reflect the activities performed at ARLLC, section supervisors and managers are required to review all documents and recommend changes to the LQAP annually. ARLLC's QA Manager is responsible for coordinating document revisions and ensuring that all staff members have access to the most current laboratory documents.

5.2 Document Control

ARLLC′s Quality Assurance Program requires that all forms and SOPs used within the laboratory be monitored to ensure that only the currently approved versions are in use. The QA Manager maintains electronic versions of all SOPs, forms and manuals in ARLLC's "cloud" based Microsoft SharePoint™ file system. These electronic files are the only official controlled copies.

Printed copies are considered "Uncontrolled". Documents in use by individual analysts or sent to clients are "Uncontrolled". All documents will include a revision date. The LQAP and SOPs will also have an effective date. The time between the revision and effective dates is used for training and orderly implementation of changes. The listing of documents (SOPs, forms, bench sheets, etc.) in ARLLC's "cloud" based Microsoft SharePoint™ file system is considered the only official listing of ARLLC's QA documents. SharePoint also includes copies of prior versions of QA documents.

The QA Manager coordinates the generation of new forms or SOPs and modifications to existing documents. Document number assignments will be as follows:

Laboratory Section	Form Number	SOP Number
Client Services	0001 - 0999	001 - 099
Computer Systems	1000 - 1999	100 - 199
Data Services	2000 - 2999	200 - 299
Extractions	3000 - 3999	300 - 399
GC Laboratory	4000 - 4999	400 - 499
Metals Laboratory	5000 - 5999	500 - 599
Conventional Laboratory	6000 - 6999	600 - 699
Volatile Organic Laboratory	8000 - 8999	700 - 799
Semi-volatile Laboratory	7000 - 7999	800 - 899
Quality Assurance Monitoring	10000 - 10999	1000 - 1099

Document numbers will include an F for forms and an S for SOPs i.e., 101F or 1234S.

Laboratory forms and SOPs will be generated or revised on an "as needed" basis and will be reviewed and revised at least annually. SOPs are prepared in a consistent format provided in SOP 1006S, "Document Preparation, Control, and Archival. A comprehensive review of all laboratory documentation will be performed annually coordinated by the QA Manager.

All documents generated by the laboratory are considered proprietary and must not be shared outside of the laboratory without prior consent from ARLLC.

5.3 Reference Documentation

To provide an understanding of the procedures employed to generate quality data, a comprehensive set of reference materials is available to staff members. The laboratory maintains copies of the following method compilations:

Code of Federal Regulations (Section 40)
Test Methods for Evaluating Solid Waste (USEPA SW-846)
Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series methods)
Standard Methods for the Examination of Water and Wastewater
Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)
Hazardous Waste Remedial Actions Program (HAZWRAP)
IEC/ISO 17025
State of Alaska Department of Environmental Conservation (ADEC)
Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods
Washington Department of Ecology (WDOE) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)
Washington State SARA
Washington State EPH/VPH Methods
TNI -The NELAC Institute Standard 2009
Department of Defense Quality Systems Manual (QSM Versions 5.3 (2019))
Washington State Sediment Sampling and Analysis Plan

Other methods followed within the laboratory are also available. Published modifications to analytical methods will be reviewed and incorporated into laboratory SOPs. If a method for a parameter is developed by ARLLC, it will be detailed in an SOP. SOPs will be available for all laboratory activities. A listing is available in ARLLC's SharePoint™ "SOP" Library.

The Laboratory Quality Assurance Manual provides an overview of the laboratory-wide Quality Assurance program. An electronic copy of the Quality Assurance Manual is available to all laboratory sections in ARLLC's SharePoint™ "Popular Documents" Library.

ARLLC maintains a file of various laboratory and environmental publications and reference texts. These reference materials are available to all staff in ARLLC's SharePoint™ "QA Reference" site. Operation and maintenance manuals are available for all equipment and instrumentation used within the laboratory. Additionally, senior level staff members are available to serve as reference sources. These staff members have numerous years of pertinent experience and can provide insight and guidance for all procedures and laboratory activities.

5.4 Quality Assurance Policies

Quality Assurance Policies provide standards and procedures to guide ARLLC employees in proper implementation of the QA Program. Appendix P includes current QA Policies.

5.5 Worksheets and Logbooks

Use of Laboratory Forms and Logbooks

All activities noted in writing on laboratory forms and logs are recorded in blue ink. Initials of the staff member performing the activity, as well as the date the activity is performed are noted on all forms and logs. Any supplementary information about the activity, such as unusual observations or suspected procedural errors is noted on the forms and logs.

A change to existing information is annotated by drawing a single line through the original entry, initialing, and dating the deletion. Correct information is then written above the deleted entry. When appropriate to clarify the intent of the change a note describing the reason for the change is added. The use of correction fluids or other techniques that cover an entry in its entirety is forbidden on laboratory documents.

Since sample processing within an analytical laboratory involves many detailed steps, documentation can be quite extensive and varied. The following guidelines ensure consistency in laboratory record keeping:

Analytical Standard Preparation

Document the preparation of all stock and working standards in Element LIMS. Each record includes preparation date, initial and final concentrations (including solute and solvent amounts), standard ID number, expiration date and the identity of the person preparing the standard. Stock solution entries include standard lot number and supplier. Working solution entries include the stock solution ID number.

Sample Storage Temperature Logs

The temperature of all refrigerators and freezers used for sample and standards storage is monitored daily using the electronic “Thermologger” system monitored and maintained by QA.

Balance Calibration Logs

The true and measured values for each calibration check weight are recorded in balance specific logbooks, along with the date and recorder's initials. Any actions taken, such as notifying QA of malfunctions is indicated alongside the entry for that date.

Instrument Sequence Logs

The Instrument Sequence Logs maintained in Element LIMS document the daily operation of each analytical instrument. The logs document the ID, date and time for each sample analyzed. In addition, instrument conditions, analyst ID and standards used and any unusual circumstances are recorded in the log. Comments related to sample analysis and minor maintenance are noted on the instrument logs. For GC/MS analyses, instrument performance is documented by recording internal standard response alongside the sample identification.

Sample Preparation/Analysis Worksheets

Sample preparation and analysis activities are documented on appropriate worksheets. Sample identifications, weights or volumes used, intermediate cleanups, final volumes, preparation dates and analyst initials will be noted as well as any observations about sample condition. Any issues encountered during sample preparation are also noted. Surrogate and spiking solution ID numbers, and concentrations added to the samples, must be indicated on the bench sheets. Worksheets are generated manually, scanned and attached to an analytical batch in Element LIMS as a PDF file.

For some parameters, analytical results are summarized on an analysis worksheet. Sample identifications, sample preparation information, sample results, quality control results, analysis date, analyst initials and reported detection limits must be indicated on the worksheet. Any necessary data qualifiers are also noted on the worksheet. Worksheet data is manually entered in Element LIMS

Maintenance Logs

All maintenance performed on instrumentation or laboratory equipment must be documented in Element LIMS. Maintenance performed, date and analyst performing the maintenance,

and steps taken to verify that the maintenance was successful are detailed. A demonstration that GC instruments are in-control following maintenance is documented in the instrument run log.

5.6 Document /Data Storage and Archival

Logbooks

Completed hardcopy logbooks are forwarded to the QA Manager to be indexed and archived for 10 years.

Analytical Records

Copies of all analytical records (project information, instrument logs, chromatograms, calibrations, quantification reports, etc.) are maintained as part electronic files on ARLLC's servers. The files are backed up to "Cloud" storage daily. All electronic data is archived for five (5) years or as specified by contract.

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SECTION 6: PURCHASING SERVICES AND SUPPLIES

ARLLC ensures that purchased supplies, consumables and services that affect the quality of environmental tests are of required or specified quality. This includes all chemicals (solvents, chemical standards, reagents, etc.) used in an analytical process and services provided by an outside vendor such as balance, weight and thermometer calibrations, support equipment maintenance and service contracts for instrumentation.

Laboratory managers or their designee are responsible for the quality and suitability of supplies and equipment routinely used in their laboratory section. This involves accurately defining required specifications for all purchased supplies, equipment and services. Purchasing documents are prepared that adequately describes the services or supplies and their specifications.

Suppliers are approved based on the quality of their products, their ability to deliver products as requested, the overall quality of their services, and competitive pricing. Documentation used in the evaluation process may include but is not limited to: Certifications by recognized accrediting organizations, evidence of quality furnished by the supplier, certificates of analysis, recommendations from other purchasers, and records of historical compliance with ARLLC's requirements. A list of approved vendors is maintained by ARLLC's QA department, is available to all staff and is reviewed and updated annually. Quality critical consumables and equipment must be purchased from an approved vendor or specifically approved by a laboratory manager.

Upon receipt, ARLLC inspects all supplies received for consistency with the order and to document any shipping damage such as breakage or leaks. ARLLC's purchaser must verify that the quality of any chemical received (expiration date, concentration, grade, etc.) meet specifications. Supplies received are stored according to manufacturer's recommendations, laboratory SOPs or test method specifications. Purchased supplies and reagents that affect the quality of the tests are not used until they are inspected or otherwise verified as complying with requirements defined in ARLLC's analytical SOPs.

Chemical or certified products are documented in Element LIMS and are labeled with an Element ID. Electronic copies of all quality documents received with the supplies and services (specifications, certificates of analyses, warranties, maintenance records, calibration

recordetc.tc) are archived and electronically linked to the Element LIMS identification. Details are found in SOP 1013S, Chemical and Certified Product Receiving.

SECTION 7: SAMPLE COLLECTION

Analytical Resources Inc. is not routinely involved with sample collection. The laboratory does, however, supply clean sampling containers to its clients upon request. Contamination free container are essential to maintaining the integrity of samples collected in the field.

7.1 Sample Container Preparation and Shipment

To minimize the possibility of contamination from containers furnished by outside sources, ARLLC will furnish all necessary sample containers for client projects. Sample containers provided by ARLLC are either pre-cleaned to EPA specifications, certified clean by the manufacturer or tested for contamination by ARLLC. Lot numbers for containers are tracked to link bottle orders to lot numbers.

As per client request, the appropriate blank sample labels are either provided to the client in bulk fashion (loose) or are affixed to each sample container prior sending the containers to a client. The sample label allows for recording of the following information at the time of collection: client name, client sample identification, sampling site, date and time of sample collection, analytical parameters, and any preservatives used. Sample labels provided by ARLLC are coated to prevent bleeding of recorded information when they become wet.

To ensure that the correct number of appropriate sample containers are prepared and submitted to the client, a Bottle Request is completed by a Client Services staff member or Project Manager at the time sample containers are ordered by the client. All necessary preservatives are also noted on the Bottle Request. The Bottle Request is then forwarded to appropriate personnel in the Sample Receiving Section for order preparation. All required containers will be gathered, and preservatives added as specified. A copy of the Bottle Request accompanies the sample containers to allow the client to verify that the order is properly filled. Additional containers will be supplied for quality control purposes and in case of container breakage or sampling complications. A listing of containers and preservatives recommended for analyses performed by ARLLC are listed in the document “Summary of Sample Containers, Preservatives and Holding Time Requirements” in ARLLC’s “cloud” based Microsoft SharePoint™ file system

To facilitate transportation of containers to the sampling site, sample containers will be placed in coolers along with appropriate packing material. The inclusion of packing materials, such as

vermiculite or “bubblewrap”, is provided to minimize the possibility of container breakage and cross-contamination. Sample containers will be organized in the coolers per analytical or client specifications. Depending on client preference and project requirements, coolers and sample containers will be shipped to a specified location, delivered by ARLLC courier, or held at the laboratory for pick up. To ensure that sample identification, analytical parameters, and sample custody are properly documented, Chain of Custody records will accompany all sample container shipments. When appropriate, as for drinking water source sampling events or for parameters that require preservation in the field, sample collection instructions will also be included with shipments.

SECTION 8: SAMPLE RECEIPT AND CONTROL

All samples received must adhere to ARLLC's "Sample Acceptance Policy" reproduced in Appendix E. Acceptable samples are logged into Element LIMS which provides for tracking the location and status of samples throughout the analytical process. Following analysis, remaining sample is safely disposed following Washington State Department of Ecology protocol. Documentation of all sample control activities and adherence to standard procedures is an important aspect of ensuring that data quality objectives are met. All samples received by the laboratory are processed in a central Sample Receiving area. To ensure the safety of staff members receiving samples, coolers will be opened under a hood or in a well-ventilated area. Appropriate personal protection, such as disposable gloves, safety glasses and laboratory coats are worn during sample receipt and log-in and all general safety practices specified in ARLLC's Chemical Hygiene Plan are followed.

8.1 Sample Admission

Sample receiving procedures are detailed in ARLLC's SOP 1001 and outlined below:

1.Chain of Custody documentation is completed.

2. Each sample container is examined to verify that the condition is acceptable, and that sample integrity has not been compromised during shipment. The condition of samples and their packaging material is documented on a "Cooler Receipt Form".

3.The number and type of sample containers received will be verified against the Chain of Custody record

4. A corrective action is initiated for sample containers broken during shipment. Compromised sample is disposed following procedures detailed in ARLLC's Chemical Hygiene Plan (Section 5, Waste Disposal Procedures).

5 Samples are logged into ARLLC's Element LIMS, each sample container is assigned a sequential sample identification number and a Work Order (WO) is generated for the set of samples. The sample identifiers are used to monitor each sample and container throughout the analytical process. The date and time of receipt, sample temperature and any unusual

observations concerning the samples are recorded in Element LIMS. Discrepancies between the Chain of Custody record and sample containers will be noted, as well as discrepancy resolutions.

6. Client specific quality control requirements and any other pertinent information indicated on the Chain of Custody Record is recorded in Element LIMS and sample labels printed and the status of the samples is set to "Received". The sample information in LIMS is now available to authorized laboratory personnel for review.

7. Sample containers are labelled and delivered to the appropriate laboratory section. The accuracy of sample container labeling is verified by a second person.

8. ARLLC's Project Manager will review the documentation in Element LIMS and edit it as necessary to ensure the client's expectations will be met. When necessary, Clients are consulted to resolve any remaining discrepancies. When the Project Manager is satisfied that the information in Element is complete and correct, she/he will set the sample status to "Available".

9. Laboratory supervisors are responsible for timely analysis of all "Available" samples.

8.2 Subcontracting Policies

ARLLC may subcontract analysis to other laboratories. QA Policy 15 (Appendix I) is followed to ensure that data produced by a subcontractor is high quality, defensible and will meet the client's expectations.

8.3 Sample Custody

To ensure the integrity of sample processing, ARLLC documents the custody of all samples from the time they arrive at the lab until their final disposal.

The National Enforcement Investigations Center (NEIC) of EPA defines custody in the following ways:

It is in your actual possession, or
It is in your view, after being in your physical possession, or
It was in your possession, then you locked or sealed it up to prevent tampering, or
It is in a secure area.

Sample and extract custody are documented in ARLLC's Element LIMS. All specific locations where samples (including extracts and digestates) are stored or processed in ARLLC's facility are assigned a unique LIMS identification. Each sample container is also assigned a unique LIMS identification. Location and sample labels include an identifying bar code. When a sample is moved from one location to another the change is documented in LIMS by scanning the bar code of the location and sample. LIMS also records the analyst who moved the sample. This process produces an electronic "Chain of Custody" for each sample container as it moves through the laboratory from initial receipt through final disposal.

8.4 Special Custody Considerations

To avoid possible cross-contamination of low-level samples in ARLLC's VOA laboratory, those samples known or suspected to contain high levels of contaminants, such as underground storage tank (UST) samples, will be segregated from other samples prior to analysis.

Samples with a very short holding time or require "RUSH" analysis may be delivered directly to the lab.

Soil samples for the USEPA Contract Laboratory Program are considered USDA "Regulated Soil", must be segregated from other samples and require special disposal procedures. The special requirements are outlined in Sample Receiving SOP 101S.

Clients may request that samples be preserved and archived prior to analysis.

8.5 Sample Archival and Disposal

After completion of analysis, unused sample aliquots are routinely stored for 30 days (water) or 60 days (soil). Samples with specific storage requirements such as "freeze and hold" are designated in Element LIMS and annotated labels are applied. Sample volumes that are to be shared between multiple laboratories are designated as "shared" in Element LIMS and the sample containers receive yellow markers prior to delivery to Refrigerator 36 ("share" refrigerator).

Analytical data in Element LIMS is used to identify samples containing analytes at or above regulatory disposal levels. Those are identified and handled as hazardous waste. A designated staff member coordinates periodic pickup of hazardous waste by an USEPA approved TSD

(Treatment, Storage, and Disposal) Company and maintains hazardous waste disposal records Specific guidelines for handling hazardous samples and waste are detailed in ARLLC's Chemical Hygiene Plan (Section 5, Waste Disposal Procedures).

SECTION 9: PROJECT MANAGEMENT AND TRACKING

9.1 Project Management

Concise and accurate communication between a client and ARLLC, and within the laboratory, is a critical component of the analytical process. ARLLC's Project Managers (PM) coordinate this communication. PMs serve as the central focus for all project related activities and communications. The PM confirms that project requirements are consistent with laboratory capabilities, and coordinates with laboratory sections to provide analytical results within specified project timelines.

ARLLC's PM will review work plans and requirements for all pending projects. Any questions related to the work plan are resolved prior to project commencement. The PM will consult with appropriate analytical sections to clarify any issues regarding procedures and capabilities. Project deliverables requirements are finalized at this time. Upon receipt and log-in of project samples, the PM will review all documentation to ensure that samples were properly logged in, and that analytical and QC requirements were correctly specified. The Project Manager also provides any additional project related information that will assist the analytical sections with sample analysis. Laboratory sections do not proceed with a given work order until it is reviewed and approved by a PM. Exceptions are parameters with critical (less than 48 hour) holding times or those that arrive on weekends or holidays when none of the Project Managers can be contacted.

Throughout the project, the Project Manager will monitor all analytical activities to help ensure that the project is completed and delivered on schedule. Any issues arising during sample processing is promptly discussed with the client. Likewise, the analytical staff will be informed of any client concerns or project modifications. The PM will also resolve issues that arise during subsequent review of the analytical data by the client.

9.2 Project Tracking

Monitoring the laboratory workload ensures that adequate staffing and equipment will be available to produce quality analytical data that meets client's expectations. At the time a client project is tentatively scheduled, information regarding the project will be documented in the Element LIMS. Project specifics, sample quantities, parameters and anticipated sample delivery

dates and analytical costs are specified. Work plans and other project specific information is attached archived in Element LIMS as electronic files. Schedules for pending projects are communicated to the lab sections through periodic distribution of database printouts.

Each laboratory section is responsible for ensuring that all analyses are completed following project requirements on or before the due date. Analysts must be aware of holding times, special analytical requirements, and required turnaround times. Analytical sections will remain in close communication with the Project Management staff so that any issues arising during sample analysis can be promptly addressed or discussed with the client.

Project Managers or their designee are responsible for monitoring project status. Status reports are generated as needed from Element LIMS and are distributed to lab sections and Project Managers. These reports allow the Project Managers to identify samples which must be expedited to meet project timelines. Additionally, verbal communication between Project Managers and lab sections provides information about project status. When requested, preliminary and interim results may be forwarded to the client.

When analysis for a work order is complete, the project manager will compose a "Case Narrative" detailing the analytical process. The narrative will reference issues or concerns raised during the analysis and indicate how they were resolved. The PM then uses Element LIMS to generate a final report and invoice which are delivered to ARLLC's client. Electronic signatures are required for all outgoing digital reports, unless other arrangements have been approved by the client prior to data delivery. All ARLLC projects managers have unique electronic signatures, and they are purchased through a 3rd party provider, Entrust Datacard. Signatures are assigned to project managers and are applied to reports and packages. The signatures are secured by a vendor supplied security token and a passphrase known only to that specific project manager. The certificates are allocated for either one or two years at a time and cannot be used to secure documents past the fixed expiration date.

Clients can express their complaints, concerns, or commendations at any time by directly contacting their project manager(s) or via the link to the online survey that is included in all outbound emails initiated by any ARLLC staff member. We may also be contacted via our web

site (www.arilabs.com). All feedback – negative or positive – is added to the Corrective Actions database and is discussed during the weekly Management Review meetings.

Whenever possible, ARLLC will acknowledge the receipt of any complaint, and provide the complainant with progress reports and the final outcome. Resulting outcomes from any complaint will be made by, or reviewed and approved by, individuals not involved in the original activities in question. ARLLC will then provide formal notice of the end of the complaint-handling process (i.e., Corrective Action) to the client/complainant.

SECTION 10: ANALYTICAL METHODS

To ensure that analytical data generated are consistent and comparable, ARLLC follows clearly defined protocols for all laboratory processes and procedures. Standard Operating Procedures (SOPs) provide detailed guidelines for completing a procedure. Document control procedures and periodic audits ensure that operations are performed in accordance with the most current SOPs. All routine deviations from published methods will be noted in the SOPs. Analysis or project specific deviations are noted in Analyst Notes and reported in an Analytical Narrative.

10.1 Responsibilities

ARLLC staff are responsible for performing procedures in accordance with the guidelines specified in ARLLC's SOPs. Laboratory Management is responsible for ensuring that staff faithfully follow current SOPs. The QA Manager is responsible for coordinating periodic review and revision of SOPs. The QA Manager is also responsible for maintaining SOP document control and ensuring that the most current versions of all SOPs are available to staff members.

Deviations from SOP and method-specific analytical procedures is only allowed when prior approval has been obtained from both the client and laboratory management (documented on form 0071F). The project manager is responsible for obtaining written consent from their client regarding any departures from documented policies.

10.2 Methods

Laboratory procedures may reference any established methods specified in active versions of the following publications:

1. Code of Federal Regulations (Section 40)
2. Test Methods for Evaluating Solid Waste (USEPA SW-846)
3. USEPA Contract Laboratory Program Statement of Work for Organic Analysis
4. USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis
5. Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series)
6. Standard Methods for the Examination of Water and Wastewater
7. Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)
8. Navy Installation Restoration Laboratory Quality Assurance Guide (February 1996)
9. Hazardous Waste Remedial Actions Program (HAZWRAP)
10. State of Alaska Department of Environmental Conservation (ADEC)
11. Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods

12. Washington Department of Ecology (WA-Ecology) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)
13. The Department of Defense Quality Systems Manual (DoD-QSM 5.3 (2019))
14. Washington State Sediment Sampling and Analysis Plan

The laboratory will adhere to established methods whenever possible. Occasionally, however, procedures may be modified to meet client or project specific requests. These modifications are thoroughly documented in project files. A complete listing of SOPs is available in ARLLC's SharePoint™ SOP Library. The SOP documents available in SharePoint™ are the official, controlled versions. Analyst may print an uncontrolled version for personnel use but are required to adhere to the electronic version in SharePoint™.

10.3 Standard Operating Procedures

Standard Operating Procedures (SOPs) are detailed, step-by-step instructions for completing a laboratory operation. An SOP is available for all procedures within the laboratory, from initial project identification to final data archival. SOPs are generated for procedures developed within the laboratory and for those that follow published analytical methods.

To ensure consistency in defining procedural guidelines, all SOPs that describe analytical procedures will contain the following sections:

1) Method, matrix or matrices, detection limit, scope & application, components to be analyzed
2) Summary of the test method
3) Definitions
4) Interferences
5) Safety
6) Equipment and supplies
7) Reagents and standards
8) Sample collection, preservation, shipment and storage
9) Quality control
10) Calibration and standardization
11) Procedure
12) Data analysis and calculations
13) Method performance
14) Pollution prevention
15) Data assessment and acceptance criteria for quality control measures
16) Corrective actions for out-of-control data
17) Contingencies for handling out-of-control or unacceptable data
18) Waste management
19) References
20) Appendices, tables, diagrams, flowcharts and validation data

SOPs will be monitored through the laboratory document control system. Each SOP will be assigned a document control number as detailed in Section 5.2 of this LQAP. SOPs are revised whenever a laboratory procedure is changed or modified. All SOPs are reviewed annually by analysts proficient in performing the procedure. SOPs will be generated for each new procedure implemented within the laboratory. Review, modification, new SOP generation, and distribution will be coordinated through the QA Manager who will periodically audit the laboratory sections to verify that the most current versions of all SOPs are in use.

10.4 Method Selection and Use

Method selection is based on availability of analytical instruments and equipment, chemical standards, expected method performance and marketability. Methods defined and accepted by regulatory agencies and familiar to ARLLC's clients are preferred. The Laboratory Director or designee, in consultation with marketing, client service, and supervisory staff are responsible for selecting appropriate methods. Client or project-specific methods are used when appropriate.

ARLLC prefers the most recently promulgated method for all procedures. Section supervisors and managers are responsible for ensuring that the procedures in use reflect the requirements of the promulgated methods. Any modifications made to the method must be documented in SOPs. Method modifications may be acceptable, provided all acceptance criteria specified in the method are met.

Section supervisors and managers will review newly promulgated methods and modify established SOPs as appropriate. When possible, the annual SOP review will be coordinated with anticipated method promulgation dates. This is especially useful for large method compilations, such as SW-846. If the annual SOP review and method promulgation cannot be coordinated, SOPs are revised as soon as possible after a method has been promulgated, especially when method changes are significant.

SOPs will be generated to reflect the most commonly used methods and protocols. When ARLLC uses two or more methods for an analysis, each will have an SOP. Several methods may be incorporated into one SOP, provided that each method is clearly identified and defined in the SOP. Method modifications or special requirements for ongoing projects, or for specific programs (DoD, CLP, TNI, etc.), will be incorporated into the SOP. These requirements will be

annotated to indicate that they are project/program specific. Analysts and technicians are responsible for meeting the program specific procedures.

10.5 Method Performance

Acceptable method performance is documented for all methods prior to use. Section supervisors and managers are responsible for ensuring that method performance is acceptable and support procedures have been performed.

Method performance requires the following:

An SOP for the method. The SOP must provide sufficient detail to perform the analysis and must accurately reflect the published method. Any steps in the method for which analyst discretion is allowed must be clearly defined.

A method detection limit (MDL) performed for the method. Method detection limits must be at or lower than method-specified detection limits.

Method precision and accuracy determined. This may be determined using an MDL or IDL study. Replicates will be evaluated for precision; analyte values will be compared with spike amounts to determine accuracy. Any method-specified precision and accuracy criteria must be met.

All method performance results are reviewed and compiled by the section supervisor and reported to the QA Section. A final SOP is generated and distributed. SOPs are updated in ARLLC's SharePoint™ SOP Library.

SECTION 11: INSTRUMENT CONTROL

11.1 Detection Limits

To verify that reported limits are within instrument and method capabilities, three levels of detection have been established: method detection limits (MDL) or instrument detection limits (IDL), Limits of Detection (LOD) and Limit of Quantitation (LOQ) or reporting limits (RL). MDLs and IDLs are statistically based values, determined from replicate analyses of analytical standards. LOQ or RL are equivalent to the lowest concentration of analyte used to calibrate a specific analytical procedure. All limits will be calculated, summarized, and maintained (in SharePoint) by the QA Manager and are documented in Element LIMS. The QA Manager will share newly generated MDLs with primary analysts any time updates are made to existing limits.

Method Detection Limits

The method detection limit (MDL) is considered the lowest concentration of an analyte that a method can detect with 99% confidence. Detailed procedures ARLLC uses to determine MDLs are published in SOP 1018S. Method detection limits are established and verified for all analytical parameters except those for which there is no spike available.

MDL studies are conducted for all analyses performed by the laboratory on representative water, sediment and, tissue samples when appropriate and suitable sample matrices are available. MDL studies are performed on all instruments used for sample analysis. To allow for reevaluation of method performance, at least two spiked samples are analyzed each calendar quarter. These analyses are used to evaluate MDLs on an annual basis. An MDL study must be performed annually for each method used to analyze drinking water. MDL studies must be performed following changes in analytical methods or instrumentation.

11.2 Analytical Standards

Generation of high-quality results is dependent upon the use of accurately prepared analytical standards. Many stock standards used within the laboratory are commercially prepared solutions with certified analyte concentrations. Neat standards used for stock standard preparation are of the highest purity obtainable. Standard preparations are fully documented in Element LIMS.

Responsibilities

Laboratory staff involved with standards preparation must use good laboratory practices to ensure that all standards are correctly and accurately prepared, validated and documented. Management is responsible for ensuring that all staff members follow specified standards, preparation and inventory procedures. The QA Manager is responsible for periodically auditing standard preparation records to verify compliance with the laboratory Quality Assurance Program.

Organic Standards

ARLLC's Organic Analysis Lab uses commercially prepared stock solutions for instrument calibration and QC sample preparation. The manufacturers certify the accuracy and traceability of these standards. Analyte concentration(s), supplier, lot number and expiration date for the purchased standards are documented in Element LIMS. Stock solutions will be stored according to the manufacturer's instruction.

The purchased standards are diluted to prepare spiking solutions for instrument calibration and QC sample preparation. Working standard solutions are stored in amber bottles with Teflon-lined caps at appropriate temperatures. Each standard solution is labeled with the solution number, compound, analyst initials and its expiration date. The preparation and expiration of these working standards is documented in Element LIMS.

Working standards are verified accurate by comparing them with second source standards purchased from an alternate supplier.

Occasionally ARLLC will prepare standard solutions from neat chemicals. Requirements for preparation and documentation of such standards are published in ARLLC SOP 1018S.

Metals Standard Preparation

Commercially prepared single element stock solutions are used in ARLLC's Metals Laboratory. Preparation of working solutions from these single element stocks is documented in Element LIMS including the preparation date, expiration date, and analyst initials. Working calibration standards are prepared weekly for ICP analyses and bi-monthly for ICP-MS. Calibration verification standards are prepared as needed for ICP and ICP-MS analyses.

Standards preparation is performed in accordance with good laboratory practices. All preparation equipment will be thoroughly cleaned prior to and after use.

Inorganic (Wet Chemistry) Standard Preparation

Working standards for wet chemistry parameters are prepared on a daily basis and documented in Element LIMS. Stock and check standard solutions are replaced when they expire or are consumed. Stock and check standard solutions are labeled with the compound, preparation data (weight and volume), units of concentration, preparation date, expiration date, and analyst initials.

Standards preparation is performed in accordance with good laboratory practice. Glassware and other preparation equipment is thoroughly cleaned prior to and after use. Standard material weights and solution volumes will be accurate to ± 3%. Stock standards will be stored in appropriate containers at recommended temperatures.

11.3 Calibration

Instrumentation used in analytical processes must be in optimal operating condition and properly calibrated to ensure that ARLLC's data is of known and documented quality. Instrument verification and calibration are essential components of ARLLC's analytical procedures. Optimum operating conditions are verified through various tuning and calibration procedures outlined below. The procedures and acceptance criteria for evaluating the operation and calibration of instrumentation are detailed in ARLLC's analytical SOPs.

Gas Chromatography and Gas Chromatography/Mass Spectrometry (GC/MS)

The performance of GC/MS systems for either VOA or SVOA analyses is verified and documented through analysis of the following standard solutions:

1. Tune check is required prior to GCMS initial calibrations and prior to 600 series method sequences.

2. Calibration Standards- between five and eight calibration standards are analyzed immediately following instrument performance is verified. Each GC/MS must meet calibration criteria specified in the analytical SOP.

3. A Continuing Calibration Verification standard is analyzed at a minimum of every 12 hours for GC/MS or 10 samples for GC analyses during an analytical sequence. For continuing calibrations, minimum response factor and percent difference criteria are considered in evaluating the acceptability of the calibration.

The composition of the standards is method/analysis specific. System evaluation is performed prior to sample analysis. Evaluation criteria used for GC/MS analyses are as specified in analytical SOPs.

The analyst performing the calibration will include documentation of any problems encountered during the calibration analyses with the data and will also note any corrective actions taken. Verification and calibration data is maintained in ARLLC's Element LIMS.

Internal standard responses and retention times for all standards are evaluated immediately after analysis. This serves as a baseline from which all sample internal standard responses and retention times are evaluated.

Inductively Coupled Plasma Atomic Emission Spectrometry (ICP)

1. Initial standardization is performed daily by analyzing a blank and four multiple element standards with a single concentration for each analytical wavelength.

2. The calibration is immediately verified with the analysis of an initial calibration verification standard (ICV) obtained from a source independent from the IC standard. The calibration is verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values must be within ± 10% of the true value.

3. After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte detected in the calibration blank must be ±1 RL. Calibration blanks (CCB) are analyzed immediately following each calibration verification standard analysis.

4. Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Control limits have been set at ±0.5RL and any sample determined to have a concentration below this standard is reported as undetected.

5. The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using standards of increasing concentrations. These standards are analyzed against the normal calibration curve and must be within 10% of their true value to verify linearity. At a minimum this upper range will be checked

every six months or whenever major changes are made to the instrument. Any sample analyzed with a concentration above 90% of this linear dynamic range must be diluted and reanalyzed.

6. To verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed at the start of the analytic run. Both the major interfering and the interfered with elements are evaluated.

Cold Vapor Atomic Absorption (CVAA) Spectroscopy

1. CVAA instrumentation is initially calibrated using a minimum of three standards of varying concentrations and a calibration blank. Initial calibration is performed daily.

2. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration is verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The initial calibration verification standard value must be within ± 10% of the true value whereas the CCV will be considered in control if it is within ±20% for CVAA analysis.

3. After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte detected in the calibration blank should be ±1 RL. Calibration blanks (CCB) are analyzed immediately following each calibration verification standard analysis.

4. Following calibration verification, a standard at the reporting limit is analyzed for all elements. Control limits have been set at 70–130% and any sample determined to have a concentration below this standard is reported as undetected. Any sample determined to have a concentration above the high calibration standard must be diluted and reanalyzed.

Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

1. Initial standardization is performed daily by analyzing a blank and four multiple element standards.

2. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration is verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values will be within ± 10% of the true value.

3. After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte in the calibration blank must be ±1 RL. Calibration blanks (CCB) are analyzed immediately following each calibration verification standard analysis.

4. Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Control limits have been set at ±0.5RL and any sample determined to have a concentration below this standard is reported as undetected.

5. The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using high level standards. These standards are analyzed daily, or as necessary, against the normal calibration curve and must be within 10% of their true value to verify linearity. Any sample analyzed with a concentration above 90% this linear dynamic range must be diluted and reanalyzed.

6. To verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed at the beginning of the analytic run. Both the major interfering and the interfered with elements are evaluated.

Inorganic Analyses other than Metals (Conventional Analyses)

Instrumentation and equipment used in analyzing samples for conventional wet chemical parameters (predominantly inorganic anions and aggregate organic characteristics) are evaluated through the analysis of either internally prepared primary standards or externally derived Standard Reference Materials.

Depending upon the analysis, calibration is based upon direct stoichiometric relationships, regression analysis, or a combination of the two. Stoichiometry generally involves standardization of a titrant against a known primary standard and then the use of that titrant for determining the concentration of an unknown analyte (e.g., the use of sodium thiosulfate in the iodometric titration of dissolved oxygen). Regression analysis involves the determination of the mathematical relationship between analyte concentration and the response produced by the measurement employed. Regression analysis is used for colorimetric determinations, ion specific electrode analysis and ion chromatography. The curve of response versus concentration is fit by the method of least squares using linear, polynomial or logarithmic regression dependent upon the pattern of response being measured. The regression coefficient will be greater than or equal to 0.995 for the calibration to be considered acceptable.

Calibration is repeated as required by the analytical method, ARLLC's SOP or specific instrumentation. Immediately following calibration, the analysis of an Initial Calibration Verification standard (ICV) and Initial Calibration Verification Blank (ICB) verify the standardized titrant or the calibration curve. The verification standard is derived from a source other than that used for standardization or development of the standard curve. The ICV must return a value within 10% of its known concentration. The ICB must be less than the Reporting Limit (RL) or

the lowest point on the standard curve, whichever is less. Initial calibration verification must be successfully completed prior to the analysis of samples.

Calibration verification is repeated after every ten samples processed during an analytical run. This Continuing Calibration Verification (CCV) will validate the method performance through an analytical sequence. If the continuing calibration values for either the standard or blank are out-of-control, the analyst will prepare a fresh CCV standard to verify the outlying condition. When the condition is verified, the analysis will stop, and the method will be re-calibrated. All samples run between the outlying CCV and the preceding in-control CCV will be re-analyzed. In-control verification standards and blanks must bracket all samples within an analytical run.

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SECTION 12: DATA VALIDATION and REVIEW

ARLLC performs four levels of review on one hundred percent of laboratory data generated. The review process is outlined below and detailed in SOPs 206S-Inorganic Data Review and 207S-Organic Data Review.

The four levels of review are:

1. Analyst review
2. Peer review
3. Supervisory review
4. Administrative review.

In addition, Quality Assurance coordinates a review of 10% or more of all completed data packages for compliance with ARLLC's Quality Assurance Plan. The data validation outlined below is in addition to the initial project review in Section 7 and QA reviews outlined in Section 11. A determination, at any point during the analysis, reporting, or review process that data may be unacceptable, requires a prompt corrective action. Corrective actions are determined on a case-by-case basis. Every employee involved in data reporting and review must have knowledge of ARLLC's quality control requirements and be responsible for identifying occurrences that require corrective action.

Two levels of review, such as Peer and Supervisory, may occur concurrently.

12.1 Analyst review:

Each analyst is responsible for producing quality data that meets ARLLC′s established requirements for precision and accuracy and will meet a client's expectation.

Prior to sample preparation or analysis an analyst will verify that:

1. Sample holding time has not expired.
2. A description of the sample or extract condition is described accurately on the laboratory bench sheet.
3. Specified methods of analysis are appropriate and will meet project required Data Quality Objectives.

4. Equipment and Instrumentation are in proper operating condition.
5. Instrument calibration and/or calibration verification are in control.

During sample preparation or analysis an analyst will:

1. Verify that Method Blanks and Blank Spike Samples are in control.
2. Verify that QC (replicate, matrix spike analyses, CRM, etc.) samples meet precision and accuracy requirements.
3. In addition to verifying that quality control requirements are acceptable, the analyst will review each sample to determine if any compound of interest is present at levels above the calibrated range of the instrument.
5. Check for data translation or transcription errors
6. Record all details of the analysis in the appropriate bench sheet or logbook.
7. Note any unusual circumstances encountered.

Following the analysis or sample preparation an analyst will:

1. Examine each sample and blank to identify false positive or false negative results.
2. Determine whether any sample requires reanalysis due to unacceptable QC.
3. Review data for any unusual observances that may compromise the quality of the data, such as matrix interference
4. Verify that data entry and calculations are accurate with no transcription errors
5. Document anomalous results or analytical concerns on the bench sheet, corrective action form or Analyst Notes for incorporation into the case narrative.
6. Note data with qualifying flags as necessary.
7. Enter reviewed data into Element LIMS, incorporate all necessary sample and quality control information into the data package and forward it for further review.

12.2 Peer review:

A second analyst trained in the appropriate SOPs will complete a peer review. Peer review will include at a minimum:

1. Verification that all QA (holding times, calibrations, method blanks, BS, spiked sample analyses, etc.) criteria are in control.
2. Review of the data for possible calculation and transcription errors.
3. Review bench sheets and analyst notes for completeness and clarity.
4. Approve the analytical results or recommend corrective action to the laboratory supervisor.
5. All corrections should be saved, and data should be re-queried to verify completeness before continuing review.

When a second trained analyst is. not available a peer review is not completed.

12.3 Supervisory Review:

Following analyst and peer review, data is forwarded to the laboratory supervisor for review. The supervisor will:

1. Review the data package for completeness and clarity.
2. Follow-up on the peer review recommendations.
3. All corrections should be saved, and data should be re-queried to verify completeness before continuing review

Designated reviewers normally perform the peer and supervisory reviews for GC-MS data.

12.4 Administrative Review:

Administrative review is the final data validation process. Designated reviewers in the Metals, Conventional and Organic laboratories perform administrative reviews. Personnel performing the administrative review are responsible for the final sign-off and release of the data. Administrative reviewers release the data to a Project Manager for incorporation into the final data deliverable package.

Administrative review will:

1. Verify that the analytical package submitted for reporting is complete and contains all necessary information and documentation.
2. Verify that appropriate and necessary data qualifying flags have been applied (Listed in Appendix N).
3. Verify that method blank and BS data are acceptable, quality control requirements are met for surrogates in all samples and blanks, and that all necessary re-analyses or dilutions were performed.
4. Check the technical validity (i.e., are total metal ≥ dissolved metals, is the cation/anion balance correct, etc.) of the complete data set.
5. Verify that all necessary final data reports are generated and that all necessary data and documentation are included in the package.
6. Approve data reports for release.

12.5 Quality Assurance Review

10% of all final data packages are reviewed by ARLLC's QA staff for QA/QC compliance This assessment includes, but is not limited to, review of the following areas:

1. Reporting and analysis requirements
2. Initial and continuing calibration records
3. Quality control sample results (method blank, BS, spikes, replicates, reference materials)
4. Internal and surrogate standard results
5. Detection and reporting limits
6. Analyte identifications

Data review activities are summarized and documented by the reviewer. The review notes are filed with the associated raw data in the project file. Any QA-related deficiencies identified during the data review will be forwarded to the QAM for corrective action.

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SECTION 13: QUALITY CONTROL SAMPLE ANALYSIS AND EVALUATION

Routine analysis of quality control (QC) samples is necessary to assess or validate the quality of data produced in ARLLC's laboratory. ARLLC routinely utilizes the following quality control analyses as defined in Section 11.3:

1. method blank (MB)
2. storage blank (SB)
3. surrogate standard analyses (SS)
4. blank spike (BS)
5. blank spike duplicate (BSD)
6. certified reference material (CRM)
7. sample (matrix) duplicate (MD)
8. matrix spike (MS)
9. matrix spike duplicate (MSD)

The number and type of QC analyses depend on the analytical method and/or the QA/QC protocol required for a specific project. A range of acceptable results is defined for each type of QC analysis. When the results of all quality control analysis are acceptable, the analysis is considered to be "in-control" and the data suitable for its intended use. Conversely, quality control sample results that do not meet the specified acceptance criteria indicate that the procedure may not be generating acceptable data and corrective action may be necessary to bring the process back "in-control".

Detailed information concerning sample preparation batches, QC analyses and surrogate standards follow:

13.1 Sample Preparation Batch

All QC samples are associated with a discrete sample preparation batch. A preparation batch is defined as 20 or fewer field samples of similar matrix processed together by the same analysts, at the same time, following the same method and using the same lot of reagents. Additional batch requirements may be specified in ARLLC's standard operating procedures. Each preparation batch is uniquely identified. All samples, field and QC, are assigned an Element LIMS ID number and are linked to their respective preparation batch. Each sample batch will contain all required QC samples in addition to a maximum of twenty field samples.

ARLLC will accommodate client, QC protocol or QAPP specific sample batching schemes.

13.2 QC Sample Requirements

Each preparation batch will include, at a minimum, a method blank (MB) and a blank spike (BS). Additional QC samples may be analyzed based upon the specific QC protocol, data deliverable or client requirements. ARLLC recommends that QC samples used to measure analytical precision also be included in each sample batch. These may include: a matrix spike and a matrix spike duplicate pair; a sample duplicate and a matrix spike pair or a Blank Spike Duplicate (BSD) for comparison with the Blank Spike (BS).

13.3 QC Sample Definitions

13.3.1 Method Blank (MB)

A method blank is an aliquot of water or solid sample matrix that is free of target analytes and processed as part of a sample batch. An acceptable method blank verifies that contaminants or compounds of interest are not introduced into samples during laboratory processing. Method blanks are spiked with surrogate standards for all organic analyses.

ARLLC defines an acceptable method blank as one that contains no target analytes at a concentration greater than ARLLC's reporting limit or 5% of an appropriate regulatory limit or 10% of the analyte concentration in the sample whichever is greatest. Clients may specify other MB acceptance criteria on a project basis.

A minimum of one method blank will be included in each preparation batch. A maximum of twenty samples may be associated with one method blank. An acceptable method blank is required prior to analysis of field samples from a preparation batch.

The results of the method blank analysis will be reported with the sample results.

13.3.2 Storage Blank (SB)

Storage blanks are organic-free water samples placed in each volatile organic sample storage refrigerator to monitor for possible cross-contamination of samples within the storage units. A storage blank from each refrigerator will be analyzed every 7 days. Storage Blank analyses is reviewed by laboratory management and archived in ARLLC's Element LIMS.

13.3.3 Blank Spike Sample (BS)

A BS is processed as part of each preparation batch and is used to determine method efficiency. A BS is an aliquot of water or solid matrix free of target analytes to which selected target analytes are added in known quantities. Analytes spiked into BS samples are listed in ARLLC's method SOPs. BS samples are spiked with surrogate standards for all organic analyses.

Following analysis, the percent recovery of each added analyte is calculated and compared to historical control limits. Current control limits are available in Element LIMS. When calculated recovery values for all spiked analytes are within specified limits, the analytical process is considered in control. Any recovery value not within specified limits requires corrective action prior to analysis of client samples from the associated preparation batch.

A minimum of one BS will be prepared for each sample preparation batch. BS analyses for those methods not requiring pre-analysis sample preparation are performed after each continuing calibration. The results of all BS performed are reported with the sample results. A maximum of twenty samples may be associated with one BS.

Clients or QA protocol may require the analysis of a duplicate BS. When BS duplicates are analyzed the failure to meet QC limits of any analyte in either BS will trigger a corrective action.

13.3.4 Replicate Analysis

Replicate analyses are often used to determine method precision. Replicates are two or more identical analyses performed on subsamples of the same field sample at the same time. Replicate analyses should be performed on samples that are expected to contain measurable concentrations of target analytes.

The calculated percent difference between replicates must be within specified limits or corrective actions are required. Percent differences exceeding the specified limit signal the need for procedure evaluation unless the excessive difference between the replicate samples is clearly matrix related.

For inorganic analyses, a minimum of one replicate set is processed for each analytical batch. Replicate sample analyses are not routinely performed for organic parameters. Instead, analytical precision is evaluated through the analysis of a duplicate matrix spike sample (MSD).

In order to perform replicate analyses, ARLLC's must receive sufficient volume to prepare the replicate aliquots.

Field replicates submitted to the laboratory are analyzed as discrete samples.

13.3.5 Matrix Spike

A matrix spike is an environmental sample to which known quantities of selected target analytes are added. The matrix spike is processed as part of an analytical batch and is used to measure the efficiency and accuracy of the analytical process for a particular sample matrix. The analytes spiked into MS samples are listed in ARLLC's method specific SOPs. MS samples are spiked with surrogate standards for all organic analyses.

Following MS analysis, the percent recovery of each spiked analyte is calculated and compared to historical control limits. If recovery values for the spiked compounds fall within specified limits, the analytical process is considered to be in control. When calculated recovery is outside of historical limits corrective action is recommended.

Matrix spike duplicate (MSD) analyses are often used to measure method precision and accuracy. In this case the relative percent difference (RPD) for recovery of spiked compounds is calculated and compared to established criteria.

When directed by a client, ARLLC will prepare a matrix spike and a duplicate with each batch of samples for inorganic analysis and an MS/MSD set for each batch of samples for organic analyses. Analyte recovery and RPD values are reported with sample data.

13.3.6 Reference Material (RM)

A CRM (Certified Reference Material) is material analyzed and certified by an outside organization to contain known quantities of selected target analytes independent of analytical method. CRMs are purchased from outside suppliers and are supplied with acceptance criteria and a signed certificate of analysis.

SRM (Standard Reference Material) are like CRMs but may come with no certificate of analysis (i.e., Puget Sound Reference Material)

Analysis of a RM (Reference Material) is used to assess the overall accuracy of ARLLC's analytical process. RMs are routinely analyzed with each batch of samples for wet chemistry (conventional analysis) and for organic and metals analysis when requested.

Any information received with a SRM will be attached to the standard entry in Element. Each CRM must be accompanied with a signed certificate of analysis from the vendor. The certificate of analysis .pdf must be attached to the standard entry in Element. Control limits will be taken directly from the certificate using the acceptance interval whenever possible. Standard deviation, uncertainty and expanded uncertainty may not be used to generate CRM control limits. When acceptance interval limits are not provided by the vendor then ARLLC will use control limits of 50-150%. Compound recovery values not within the specified limit may signal the need to evaluate the analytical process.

It is important to realize that certified values in a RM may be determined using analytical methods different from those routinely used by ARLLC. For this reason, direct comparison of ARLLC's results with certified values may not be a valid indicator of the laboratory's proficiency.

13.3.7 Other Quality Indicators

In addition to analyzing the quality control samples outlined previously, various indicators are added to environmental samples to measure the efficiency and accuracy of ARLLC's analytical process. Surrogate standards are added to extractable organic samples prior to extraction to

monitor extraction efficiency. Surrogate standards are also added to volatile organic samples prior to analysis to monitor purging efficiency. Internal standards are added to metals digestates for ICP-MS analyses and to organic samples or extracts prior to analysis to verify instrument operation.

The calculated recovery of surrogate analytes is compared to historical control limits to aid in assessing analytical efficiency for a given sample matrix.

13.4 Acceptance Limits / Control Limits

Acceptance limits provide a means for evaluating whether a process is in control. Acceptance limits are normally calculated from ARLLC's historic but may also be specified in an analytical method or QA protocol. These are based on internal, historical data for organic analyses and method specified limits for inorganic analyses. Samples associated with a specific program or contract (such as the USEPA Contract Laboratory Program) are evaluated against program/contract-specified criteria. Routine samples are evaluated against internally generated control limits. Project specific control limits may be used when requested following review and approved by laboratory management.

QC Limits are calculated in Element LIMS using historic data as described in SOP 1005S. Control limits will be generated for BS compound recoveries and surrogate recoveries on a method / matrix specific basis. Advisory control limits are utilized for analyses performed on an infrequent basis until a sufficient number of usable data points (20 or more) are collected. Control limits are updated at least annually but may be updated more frequently if method or instrument changes have been made. Laboratory control and acceptance limits are published in Element LIMS.

Analysts are required to verify that all QC analyzes are in control when performing an initial data review. All out of control QC recoveries require a documented corrective action. ARLLC will not use control limits for organic analyses that are greater than 80% for the lower limit or less than 120% for the upper limit.

13.5 Control Charts

Control charts, in conjunction with other control sample analyses, are useful in verifying that an analytical procedure is performing as expected. The control chart provides a pictorial

representation of how closely control sample results approximate expected values, as well as showing analytical trends. Indicated on the control chart are the mean and upper and lower warning and action limits. The warning and action limits are used to determine whether or not an analytical process is in control. The mean is used to determine whether results obtained for a procedure are trending upward or downward, which may ultimately affect the accuracy of sample results.

Control charts are generated from historical data using Element LIMS. The QA Manager will coordinate generation of control charts based on laboratory data at least quarterly. These control charts are distributed to and reviewed by section supervisors and managers. Any significant trends or variations in results will be identified, and the source of the trend corrected. At the bench/instrument level, individual results from quality control samples are evaluated against the acceptance limits.

SECTION 14: LABORATORY CORRECTIVE ACTIONS AND REESTABLISHMENT OF CONTROL

To produce quality data, it is important that all aspects of the analytical process are under control and that all specified quality control criteria are met. Occasionally, however, procedures, reagents, standards, and instrumentation fail to meet specified criteria. Should any of those situations occur, the quality of data produced may be compromised. When procedures no longer appear to be in control, sample processing is halted, and appropriate actions will be taken to identify and rectify any instrument malfunctions or process-related issues. Prior to resuming sample analysis, verification of control is made through the analysis of various control samples. Actions taken and observations made during reestablishment of control are fully documented on the associated laboratory bench sheet or Analyst Notes form. Only when control is regained and all actions documented will sample processing resume. This ensures that no results generated during the suspect period are reported.

14.1 Responsibilities

It is the responsibility of all laboratory personnel involved with sample processing to determine whether or not a procedure is in control and to verify that all data are produced under conditions that are “in control”. It is at the analytical level that unacceptable conditions are most easily detected and corrected. Laboratory personnel are also responsible for employing and documenting all necessary corrective actions taken to regain control of a procedure. Samples processed during suspect periods are reprocessed, and suspect data will be appropriately annotated to indicate that it is of questionable quality. Analytical staff will verify that all data submitted for review has been generated under acceptable conditions. All anomalies are documented on the Analyst Notes form and must include such information as: type and source of anomaly, reasons for the anomaly, and actions taken to correct the problem. All personnel involved with subsequent and final data review are responsible for verifying that data is generated under acceptable conditions. If suspect data are identified at the review level, responsible analysts are contacted to determine whether additional actions (such as reanalysis)

will be taken. In addition, reviewers will confirm that anomalies noted by the analyst were addressed and that appropriate corrective actions were taken.

On occasion, it is not possible to generate data that meet all Quality Control Standards. This may be due to sample volume limitations or sample matrix effects. It is the responsibility of the analytical and data review staff to document these situations and to maintain communication with the Project Management staff. The Project Management staff, in turn, is responsible for notifying the client or specifying any additional further action. Project Managers must also ensure that clients fully understand which data are questionable and the why acceptable results could not be generated.

It is the responsibility of the QA Manager to perform regular reviews of corrective action procedures to ensure that unacceptable conditions or suspect data will be identified prior to releasing results. Section managers and supervisors are responsible for ensuring that appropriate corrective action procedures are in place and that all staff members are trained to identify and act upon "out of control" situations.

14.2 Corrective Actions

There are various stages of the analytical process where the procedure may fall out of control and require corrective action. In general, all procedures and equipment are monitored to verify that control is maintained during sample processing. The following details those stages as well as the actions taken to reestablish and verify control.

Sample Preparation

During sample preparation, all glassware associated with a specific sample will be clearly labeled to eliminate the possibility of sample mix-up or mislabeling. Laboratory staff will ensure that sample-identifying labels are accurately completed and that correct sample identification is maintained at all times. If a sample appears to have been misidentified or mixed with another sample during preparation, the suspect samples will be discarded and new aliquots taken. If there is insufficient sample for a second preparation, the situation will be documented on the bench sheet and the PM notified immediately.

Addition of surrogate standards or matrix spiking solutions is carefully monitored to ensure that all samples are accurately fortified. Volumes and standard solution numbers of all standards

added to samples are recorded on the bench sheet. If there is suspicion that a sample has been incorrectly spiked a new sample aliquot should be prepared. If there is insufficient volume for re-preparation, the bench sheet is annotated to indicate which samples may be inaccurately fortified.

When sample matrix hinders processing following standard procedures, the section supervisor or manager must be consulted for guidance on appropriate actions. Preparation of less sample or alternate procedures may be necessary. Deviations from normal analytical protocols must be documented on the bench sheet.

If at any time during sample preparation, sample integrity appears compromised or a procedural error is noted, the sample will be discarded and re-prepared. If insufficient sample volume is available for re-preparation, the situation is documented on the bench sheet and the PM immediately notified.

Calibration and Tuning

Prior to sample analysis, all analytical instruments are calibrated and tuned to ensure that equipment meets criteria necessary for production of quality data. Analytical instruments must meet the calibration criteria specified in ARLLC's SOP. When these criteria are not met, corrective actions must be completed. All corrective actions are accurately and completely documented in the "analysts notes" and attached to the calibration data in Element LIMS. The corrective action must, explain the problem, list actions taken, and document verification that the issue was resolved. Samples will not be analyzed until an initial verification of system performance has been made. When continuing calibration results do not meet criteria, sample analysis will not resume until corrective actions are completed and the system re-calibrated.

GC/MS Analyses - Analysis of the instrument performance check solution (BFB or DFTPP) will meet the specified ion abundance criteria. Initial calibration standards at a minimum of five concentrations will meet specified response factor and percent relative standard deviation criteria. If criteria are not met for initial calibration; the system will be inspected for malfunction. The initial tuning and calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

A check of the calibration curve is performed at the frequency specified in ARLLC's SOP or the referenced analytical method. All response factor criteria must be met. Additionally, the percent difference between the initial and continuing calibrations will meet specified criteria. If criteria are not met, the system will be inspected for

malfunction. The initial tuning and calibration verification will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

Internal standard responses and retention times for standards will meet specified criteria. Any sample not meeting internal standard criteria will be reanalyzed. If reanalysis yields the same response and the instrument is determined to be functioning correctly, the failure to meet criteria will be attributed to sample matrix interference. No further re-analyses will be required.

GC Analyses - Organochlorine pesticide calibrations will be evaluated using criteria specified in ARLLC's SOPs. The Resolution Check standard must meet resolution criteria and Endrin and DDT breakdown in the Performance Evaluation Mix standard must meet criteria. Initial calibrations will meet percent relative standard deviation criteria. If, during the initial calibration sequence, criteria are not met, the system will be inspected for malfunction and the initial calibration be reanalyzed. Samples are not analyzed until all initial calibration criteria are met.

Continuing calibrations using a mid-level calibration standard or a Performance Evaluation Mix standard are analyzed at the frequency required by the reference method. Specific method or matrix requirements are documented in the ARLLC's SOPs. If continuing calibration criteria are not met, the system will be inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration will be performed. After the system has been successfully corrected or re-calibrated, all samples previously analyzed between the acceptable and unacceptable continuing calibration are reanalyzed.

If, during the analytical sequence, retention time shifting occurs, the system is inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration is performed. After the system has been successfully corrected or re-calibrated, all samples with retention times outside the specified windows will be reanalyzed.

For all GC analyses other than chlorinated pesticides, initial calibration standards analyzed at a minimum of five concentrations will meet percent relative standard deviation criteria. If criteria are not met for initial calibration, the system will be inspected for malfunction. The calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

The calibration is verified after every 10 samples. All percent differences between the initial and continuing calibrations must meet specified criteria. When criteria are not met, the system will be inspected for malfunction and re-calibration will be performed. Samples analyzed between an acceptable and unacceptable calibration check will be reanalyzed.

Metals and Inorganic Analyses - Initial calibrations will be verified by analyzing a calibration check standard immediately after calibration. The calibration is verified throughout the analytical sequence by analyzing a continuing calibration verification

standard (CCV) after every 10 sample analyses. The calibration check standard values must be within ± 10% of the true value.

The calibration check standard analyzed after every 10 samples will meet percent difference criteria. If the calibration check standard is not acceptable, the system will be inspected for malfunction and re-calibration will be performed as necessary. Samples analyzed between acceptable and unacceptable calibration check standards will be reanalyzed.

Instrument Blanks

Prior to sample analysis, instrument and/or calibration blanks may be analyzed and evaluated for the presence of target analytes. When analytes are detected at levels above reporting limits, the source of contamination will be identified. Sample analysis will not commence until analyte levels in instrument and calibration blanks are below the reporting limits. Instrument and calibration blanks are analyzed for VOA analysis only if sample carryover is suspected.

Instrument and calibration blanks may also be analyzed throughout the analytical sequence. These will not contain target analytes at levels above the method detection limits for organic parameters or the reporting limit for inorganic parameters. If one or more analytes exceed the RL, an additional blank is analyzed. If analyte levels are still above the method detection limits, the system is inspected for malfunctions and the source of contamination identified and removed. Sample analysis will not resume until instrument and calibration blank analyte levels are below the RL. Organic samples analyzed between acceptable and unacceptable blanks will be evaluated using the following guidelines:

If no target analytes are detected in the samples, reanalysis is not be required.

If sample target analyte levels are above the method detection limits, reanalysis is samples at the analyst's discretion. Reanalysis will be dependent upon the concentration of the analyte and whether or not there is likelihood that contamination results from sample carryover.

If the analytes present at unacceptable levels in the instrument blank are not of interest or concern in the associated samples, reanalysis may not be required. This is often a consideration for ICP analyses where analytes of concern may be only a subset of the possible analytes.

Methods for the analysis of inorganic analytes require that all samples associated with an out-of-control blank be re-analyzed.

Method Blanks (MB)

Prior to any sample analysis, method blanks are evaluated for the presence of target analytes. Acceptance criteria for MBs are published in reference methods or quality systems documentation and detailed in ARLLC's analytical SOPs. When analytes are detected at or above acceptance criteria, a corrective action must be initiated.

Blank Spike Samples

Prior to sample analysis, a blank spike (BS) will be evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If BS recoveries are out of control, corrective action is required. Corrective actions may include one or more actions from a written explanation in the case narrative up to re-preparation and reanalysis of the entire sample batch.

Internal Standards

Some of ARLLC's analytical procedures utilizes an internal standard (IS) to assess method performance. Acceptance criteria for ISs are published in reference methods or detailed in quality systems documentation. If any internal standard does not meet acceptance criteria, a corrective action must be initiated as detailed in ARLLC's method specific SOPs.

Surrogate

Surrogate standards are commonly used to assess method performance. Acceptance limits for surrogate recovery are published in quality systems documentation or reference methods and detailed in ARLLC's analytical SOPs. When surrogate recovery values are outside acceptance limits, a corrective action must be initiated. Corrective actions are generally method specific and may result in repreparation and reanalysis of samples.

Matrix Spikes

Matrix spike (MS) analyses are performed when required by specific analytical protocol or client request. MSs are evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If unacceptable recoveries are obtained a corrective action is initiated as detailed in ARLLC's analytical SOPs. A post-digestion spike analysis will be

performed for all metals analyses that must adhere to EPA-CLP guidelines or when specifically requested by ARLLC's client

Sample and Matrix Spike Replicates

When required by analytical protocol or client's request, sample and matrix spike replicates are evaluated to verify that percent differences between the replicates are within acceptance limits. If unacceptable recoveries are obtained a corrective action is initiated as detailed in ARLLC's analytical SOPs.

Samples

In addition to monitoring sample quality control indicators, ARLLC evaluates samples to determine the need for reanalysis. Conditions considered while evaluating samples are:

If a target analyte detected in a sample exceeds the upper limit of the instrument calibration range, the sample is diluted and reanalyzed. Dilution and reanalysis continue until the analyte concentration falls within the linear range of calibration. If the sample requires dilution to such a level that surrogates are no longer detectable and analytical accuracy is questionable, the sample may be re-prepared using less sample.

Samples will be evaluated for matrix interference that may affect analyte detection and quantification. Appropriate cleanup procedures will be employed to remove interference. Samples may be diluted and reanalyzed to minimize background interference. When interference cannot be removed, reported results will be qualified as appropriate.

When, in an analyst's judgement, low-level analytes detected in a sample may result from carryover, the sample will be reanalyzed. If analyte levels remain approximately the same the initial results will be considered valid. If analytes are not detected during reanalysis, it will be assumed that the initial detection was due to carryover, and the initial results will not be reported.

If an instrument malfunction or procedural error occurs during analysis, all affected samples will be reanalyzed. If the malfunction appears to be an isolated incident, it will not be necessary to inspect the analytical system. If the malfunction appears to be an ongoing problem, the system will be inspected, and maintenance/corrective actions performed prior to resuming analysis.

Sample Storage Temperatures

Acceptable temperatures range for samples that require cooling for preservation are 0°C ≤ T ≤ 6°C for refrigerators and < -15°C for freezers. ARLLC employs an electronic monitoring system to record refrigerator and freezer temperatures every 30 minutes. When a temperature is outside the acceptance range, the system sends an e-mail message to the appropriate laboratory supervisor and the QA department. Laboratory Supervisors are responsible for determining why the temperature is "out of control" and performing a corrective action. When the cooling device will be "out of control" for more than 30 minutes the samples are temporarily transferred to a properly functioning cooler or freezer.

Balance Calibrations and Certified Weights

Analysts verify and document the accuracy of analytical balances daily before use. Balances must demonstrate a variance of < 5% or 5 mg whichever is less for weights that bracket the working range of the balance. Staff must remove an out-of-control balance from service and notify the laboratory supervisor who will initiate a corrective action. The balance is retired from service until it is repaired and demonstrated to be back in control. Staff document daily balance checks in a balance specific balance logbook.

In addition, ARLLC outsources an annual service and calibration for each balance to a NIST certified vendor.

Water Supply System

The water supply for the volatile organic and inorganic laboratories will be monitored daily for the presence of contaminants through the analysis of method and/or instrument blanks. Organic contaminants, especially chloroform, are early indicators of the need for preventative maintenance. If organic or other contaminants are detected, the system filters are changed. After filters have been changed, an additional aliquot of water will be analyzed to confirm that contaminants are no longer present.

The water supply for the metals laboratory is monitored daily. When the resistivity falls below 18 megaohm, system maintenance is performed.

Section 15: LABORATORY EVALUATIONS, AUDITS AND CORRECTIVE ACTION SYSTEM

15.1 Internal Audits

Routine evaluations or internal audits of laboratory activities ensure complete and effective implementation of established policies, procedures and quality control requirements. Findings from the evaluations allow ARLLC to discover and correct activities not in compliance with the laboratory Quality Assurance Program or accreditation program requirements. ARLLC's QAM schedules internal audits on an annual basis following the guidelines in Appendix K.

Checklists described in SOP 1005S ensure consistent and complete audits. Deficiencies noted during the course of an audit are documented as an issue using ARLLC's Corrective Action System. Issues are investigated, a root cause analysis performed, and appropriate corrective actions implemented. Follow-up audits ensure that corrective actions have been satisfactorily implemented.

When an audit finding indicates possible errors or deficiencies in analytical data, ARLLC will correct the error and notify all affected clients within 2 working days.

Activities or procedures routinely audited include: The QAM or designee routinely audits the following activities:

Balance verification records
Sample storage cooler temperature records
Oven, incubator and water bath temperature records
Chain of Custody records
Standard preparation records
Documentation and Response to Client Complaints
Chain of Custody Procedures
Documentation of Computer and Software Revisions
Calibration records
Maintenance records

Control charts

Adherence to SOPs and methods

Support system records (DI water, balances, pipettes, etc.)

Detailed review of specific analytical methods

Data package review

15.2 Audits by Outside Agencies (External Audits)

Agencies that accredit ARLLC perform periodic assessments (external audits) of laboratory procedures and/or QA documentation. These assessments may take place at ARLLC's facility (on-site audits) or may be a review of documents delivered to the assessor's location (off-site audits). External audits provide an independent evaluation of laboratory procedures without internal influence or bias. ARLLC will review all comments, deficiencies, and areas of potential improvement noted by external assessors and implement appropriate corrective actions.

Appendix M lists agencies that accredit and audit ARLLC's laboratory.

15.3 Performance Testing (PT) Analyses

PT sample analysis is an integral part of ARLLC's QA program. PT samples contains specific analytes in concentrations unknown to ARLLC personnel. Laboratories obtain PT samples from, and report analytical results back, to a specific PT provider. The provider compares the laboratory's results with "true" values and reports the results directly to accrediting agencies. Accuracy of the reported result indicates the laboratory's ability to perform a given analysis. Performance Testing (PT) sample analysis is a means of evaluating individual performance as well as the overall analytical system. PT sample analysis is a requirement of certification and accreditation programs. ARLLC routinely analyzes two PT samples annually for each of its accredited analyte/matrix combinations. ARLLC also uses PT analyses to document the analytical proficiency of individual analysts

Reports/results from PT providers are shared with department supervisors, who, in turn, share the data with the pertinent analyst(s). For every PT result outside of the PT providers acceptance range, the QA Manager opens a corrective action within the CA database and assigns the initial response responsibility to the appropriate department supervisor.

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15.4 Quality Assurance Reports to Management and Staff

In order to ensure that laboratory managers are kept apprised of quality related activities and laboratory performance on an ongoing basis, quality assurance is discussed each week during the ARLLC Staff Meeting that includes executive and supervisory staff. The agenda, at a minimum includes:

1. Information concerning current and ongoing internal and external audits
2. Status and results of current or ongoing internal or external proficiency analyses
3. Identification of Quality Control problems in the laboratory
4. Information on all ongoing Corrective Actions
5. Current status of external certifications
6. Current status of the Staff Training Program
7. Outline of new and/or future Quality Assurance Program initiatives

The application of the above combined activities provides comprehensive monitoring and assessment of laboratory performance and ensures that all data produced by ARLLC will be of the highest possible quality.

15.5 Annual Management Review

In the last quarter of each year, executive management will perform a comprehensive review of ARLLC quality system and analytical procedures to assess their continued suitability and effectiveness. Management will consider the following during the review process:

1. Suitability of policies and procedures
2. Reports from management and supervisory personnel
3. Results of internal audits
4. Corrective and preventative actions
5. Results of recent external quality systems audits
6. PT results
7. Changes in volume and type of analyses performed
8. Client Feedback
9. Complaints
10. Recommendations for Improvement

11. Topics specific to Department of Defense (DoD) accreditation (see: Form 12207F *Annual DoD Management Review*)
12. Other relevant factors such as quality control activities, available resources and analyst training

15.6 Corrective Action System

The Corrective Action System is an electronic system used by ARLLC to record errors, omissions or other issues of concern and document corrective and preventative actions taken in response to those issues. The details of the system are discussed in SOP 1005S.

Corrective Actions are initiated when any deficiencies or concerns are noted in the laboratory QA program through any of the following mechanisms:

1. Internal Assessments.
2. External Assessments.
3. Out of Control PT results.
4. Review of Analyst Notes.
5. Employee concerns or observations.
6. Anonymous Reports using Anon Staff Survey (located on intranet homepage)
7. Management Review.
8. Client complaints or concerns.

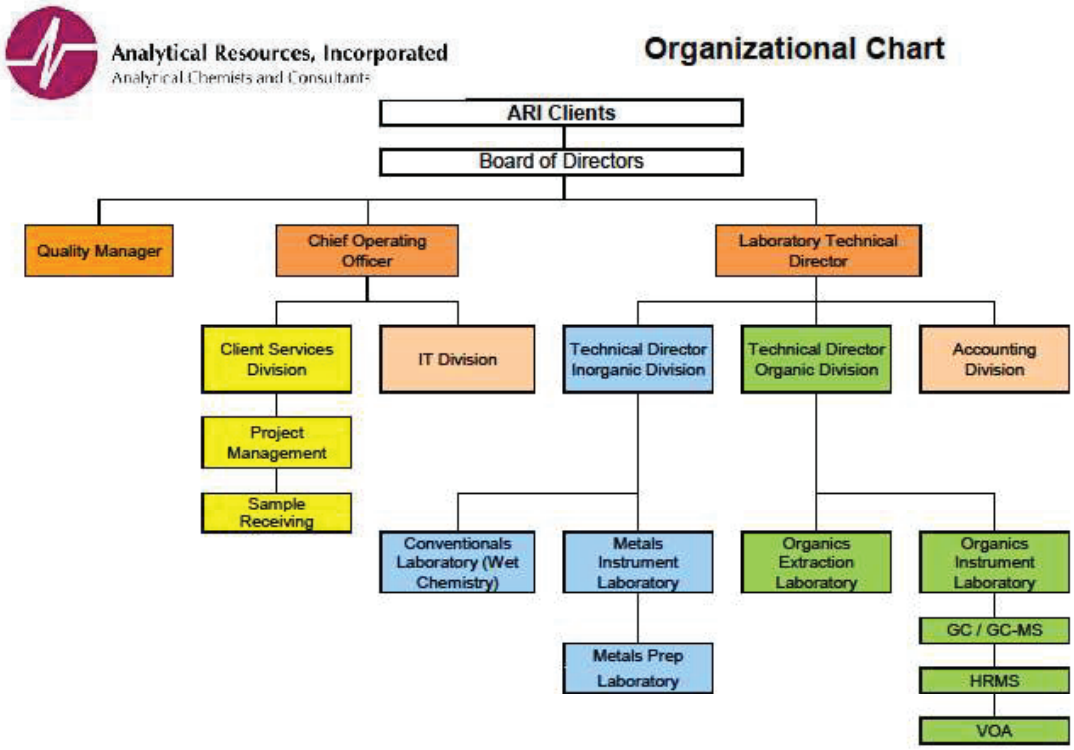
After discussing the issue with the appropriate personnel, the filed corrective actions are discussed in the weekly workload meeting with all managers and supervisors and included on the QA Quarterly report. As the issues are worked on and documented in the system, key personnel are kept informed of status via automatic email updates. The goal is to resolve all issues in a thorough and timely manner.

Section 16: APPENDICES

A. Laboratory Organization and Key Personnel Resumes
B. Training and Demonstration of Proficiency
C. Laboratory Facilities
D. Laboratory Instrumentation and Computers
E. Standard Operating Procedures
F. Sample Collection Containers, Preservation and Holding Times
G. Laboratory Workflow
H. Analytical Methods
I. Method Detection Limits and Reporting Limits
J. Quality Control Recovery Limits
K. Internal Audit Schedule
L. Laboratory Accreditations
M. Data Reporting Qualifiers
N. Standards for Personal Conduct
O. QA Policies
P. References

Appendix A

Laboratory Organization Chart
and
Key Personnel Resumes



KEY PERSONNEL RESUMES

Mark Weidner

Laboratory Technical Director

Profile

Mr. Weidner co-founded Analytical Resources, Inc., along with Brian Bebee, Sue Dunnihoo and David Mitchell. Prior to his co-founding of Analytical Resources, Inc. in 1985, Mr. Weidner was the Head Mass Spectroscopist at Michigan State University and an instructor at the Finnigan Institute. As Laboratory Director, Mr. Weidner is responsible for overall laboratory performance, as well as facility expansion and major purchasing. Mr. Weidner is intimately familiar with all operational and analytical aspects of Analytical Resources and initiated many of the procedures currently in use.

Education:

M.S., Medicinal Chemistry, Purdue University, W. Lafayette, IN (1978)

B.S., Biochemistry, Michigan State University, E. Lansing, MI (1975)

Experience:

Laboratory Director/Co-founder, Analytical Resources, LLC, Seattle, WA (1985 to present).

Senior Chemist, City of Seattle, Seattle, WA (1981 to 1985).

Instructor, Finnigan Institute, Cincinnati, OH (1979 to 1981).

Mass Spectroscopist, Michigan State University (1978 to 1979).

Brian Bebee

Technical Director-Organics Division

Profile:

Mr. Bebee co-founded Analytical Resources, Inc., along with Mark Weidner, Sue Dunnihoo, and David Mitchell. Prior to his co-founding of Analytical Resources, Inc., Mr. Bebee had gained extensive GC/MS experience as a GC/MS Chemist at the Municipality of Metropolitan Seattle, (METRO). When he co-founded ARI in 1985, Mr. Bebee became the Organics Division Manager until 1993, when he assumed the position of Laboratory Manager. As Laboratory Manager, Mr. Bebee is responsible for the day-to-day laboratory operations, including personnel, instrument, and procedural concerns. He is also responsible for the direct supervision of the Volatile and Semivolatile Laboratories.

Education:

A.A., Oceanography, Marine Biology, Biology, Shoreline Community College (1973).

Experience:

Laboratory Manager, Analytical Resources, LLC, Seattle, WA (1987 to present).
Organics Division Manager/Co-founder, Analytical Resources, LLC, Seattle, WA (1985 to 1987).
GC/MS/DS Operator, Municipality of Metropolitan Seattle, Seattle, WA (1980 to 1985).
Senior Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1976 to 1980).
Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1973 to 1976)

David Mitchell (Retired)

Quality Assurance Manager

Profile:

Mr. Mitchell co-founded Analytical Resources, Inc., along with Mark Weidner, Sue Dunnihoo, and Brian Bebee. Prior to his co-founding of Analytical Resources, Inc., Mr. Mitchell had gained extensive experience in environmental chemistry as Senior Chemist and Trace Organics Laboratory Supervisor at the Municipality of Metropolitan Seattle (METRO). His responsibilities included the management of Analytical Resources Quality Assurance/Quality Control Program.

Education:

Graduate Work in Chemistry (Organic/Biological), University of Wyoming, Laramie, WY (1970 to 1974).

B.S., Chemistry, Upper Iowa College, Fayette, IA (1970)

Experience:

Quality Assurance Manager, Analytical Resources Inc., Seattle, WA (1998 to Present)
Client Services Manager, Analytical Resources Inc., Seattle WA (1987 to 1998)
Vice President/Co-founder of Analytical Resources, LLC, Seattle, WA (1985 to 1987).
Senior Chemist, METRO Trace Organics Laboratory, Seattle, WA (1979 to 1985).
Research Associate, Northwestern University Medical School (1974 to 1979).

Susan Dunnihoo

Chief Operating Officer

Profile:

Ms. Dunnihoo co-founded Analytical Resources, Inc, along with Mark Weidner, Brian Bebee, and David Mitchell. Prior to her co-founding of Analytical Resources, Inc., Ms. Dunnihoo had gained extensive experience in environmental chemistry through her work at Laucks Testing Laboratories, the City of Tacoma, and the Municipality of Metropolitan Seattle (METRO). As Director of Client Services, Ms. Dunnihoo is responsible for assisting project managers in responding to the needs of ARI clients, and for communicating to the laboratory the analytical capabilities that required to satisfy future client needs. Ms. Dunnihoo also acts as project manager for a number of projects.

Education

Graduate work in Chemical Oceanography, University of Washington (1976-1980)
ACS Certified BA, Chemistry, Augsburg College, Minneapolis, MN (1976)

Experience

Director, Client Services, Analytical Resources, LLC, Seattle, WA (2007-present)
Client Services Manager, Analytical Resources, LLC, Seattle, WA (1998-2007)
Computer Services Manager, Analytical Resources, LLC, Seattle, WA (1985 to 2000)
Corporate Secretary, Analytical Resources, LLC, Seattle, WA (1985 to present)
Chemist, Laucks Testing Laboratories, Seattle, WA (1983 to 1985)
Chemist, City of Tacoma, Plant II, Tacoma, WA (1982 to 1983)
GC/MS/DS Operator, METRO TPSS Lab, Seattle, WA (1980 to 1982)

Casey English

Inorganic Division Manager

Profile:

Mr. English oversees ARLLC's Inorganic Division, which includes Metals Sample Preparation, the Metals Instrument Laboratory, the Conventional Wet Chemistry Laboratory and the inorganic data group. As a Section Manager, Mr. English holds the final authority in decisions concerning implementation of QA policy, with the contributions of the Laboratory Director, Laboratory Manager, QA Manager and Project Managers.

Mr. English is experienced in the environmental chemistry field, with an emphasis in inorganic analyses. Mr. English is experienced developing and maintaining both in-house proprietary methods and more routine methods and protocols (EPA, Standard Methods, etc.). He is experienced with the operation, maintenance, and repair of a large number of laboratory instruments.

Experience

2021-present	Analytical Resources Inorganic Division Manager
2015-2021	Analytical Resources Conventionals Supervisor
2008-2015	Analytical Resources conventionals Analyst

Bob Congleton

Quality Assurance Manager

Profile

Mr. Congleton has worked at Analytical Resources, LLC since 2005. Currently, he oversees ARLLC's Quality Assurance/Quality Control Program. Mr. Congleton is also responsible for managing the laboratory's hazardous waste disposal activities and leads the safety program.

Education

2013: M.A. Policy Studies – University of Washington (Bothell)
2001: B.S. Conservation of Wildland Resources – University of Washington (Seattle)

Experience

2017-present: QA Manager
2014-present: Hazardous Waste Coordinator
2008-2014: Project Assistant
2005-2008: Sample Receiving

Peter Kepler
Dioxin Analyst
Analytical Resources, LLC

Education

- BA in Biology, Colgate University, 1978
- JD, DePaul University, 1985

Experience

- Joined Analytical Resources in July 1986
- GC analyst/supervisor, 1986 - 1995
- Pesticide/PCB/Herbicide methods, including CLP contract
- GC/MS analyst, 1996 - 2010
- Various SemiVoa 8270 parameters
- Responsible for developing custom reports using Report Writer macros
- HRGC/MS analyst, 2010 -Present
- Dioxin 1613, 8290, and HRSM CLP methods

SHELLY L. FISHEL

PROFESSIONAL EXPERIENCE

Project Manager, Analytical Resources Inc. —Tukwila, WA 2017-Current

Analytical Chemists and Consultants Laboratory specializing in environmental analyses within strict quality standards delivering on time data.

- Provide legally defensible data in a fast paced, accredited laboratory in accordance with Laboratory SOPs, Environmental Protection Agency's (EPA) and local governing agencies' guidelines. Accredited by Washington Department of Ecology, Oregon Environmental Laboratory Accreditation Program, US Department of Defense, and others.

Senior Environmental Chemist/Team Lead, San Antonio Water System—San Antonio, TX 2007 to 2015

Drinking Water and Wastewater utility serving customers within the greater San Antonio metropolitan area.

- Provided quantitative, accurate and legally defensible data to all internal customers; conducted chemical and microbiological analysis of contamination within environmental samples in accordance with standard operating procedures (SOPs) and strict quality assurance/control (QA/QC) requirements.
- Managed operations of Trace Metals and Sample Receiving Sections through development of analysis plans— scheduling, coordinating, prioritizing and performing analyses of samples within requested TAT. Researched, generated and maintained SOPs; trained and ensured compliance to SOPs. Evaluated data from analysis and incoming COCs and verified proper input into Labworks Laboratory Information Management Systems (LIMS).
- Performed and maintained continual demonstration of capabilities (CDOCs) in several sections—Trace Metals by ICP ICP-MS and CVAA; General Chemistry by Distilled Ammonia and Total Kjeldahl Nitrogen (TKN) and Total Organic Carbon (TOC); Microbiology CDOCs to detect coliforms and E. coli using IDEXX-Colilert and Fecal Coliform by membrane filtration.

Scientist I – Quality Control Production, DPT Laboratories—San Antonio, TX 2004 to 2007 *Pharmaceutical development and manufacturing organization recognized for its excellence in semi-solid and liquid dosage forms.*

- Performed daily analyses using various instrumentation including HPLC-UV, HPLC- ECD, GC-FID, AA, FTIR and UV/Vis, consistently ensuring the timely release of pre- and post-packaging products including high profile products and those with controlled substances within a fast-paced, pharmaceutical CGMP, QC production laboratory.
- Consistently supported departmental goals by effectively completing tasks such as daily processing utilizing Empower Software, data calculation and initial review, review of departmental data for the release of products by deadline and with a low error rate, troubleshooting of instrumentation and chromatographic anomalies, process validation assays, and maintenance of the waste disposal schedule.

Chemistry Supervisor, Food Safety Net Services—San Antonio, TX 2002 to 2003

Leading provider of food safety laboratory services, serving multiple industries including agriculture, pharmaceuticals, hospitality, food service, retail, personal care products and more.

- Scheduled all analyses and ensured tasks were completed according to customer specifications and deadlines.
- Analyses included various wet chemistry techniques, distillation, organic extraction, Total Kjeldahl Nitrogen; various fat testing methods, and UV/Vis spectrophotometry.

Chemist, Hytek Finishes—Kent, WA 1997 to 2001

Largest independent supplier of specialized metal finishing, non-destructive testing, plating, anodizing and organic coating services in the Pacific Northwest and one of the largest in North America.

- Maintained quality control of three fast-paced, metal finishing shops with minimal supervision; performed all laboratory analyses including various wet chemistry techniques, atomic absorption spectroscopy, UV/Vis spectrophotometry, pH, titrations, corrosion resistance testing, Taber abrasion testing and adhesion testing.
- Effectively communicated statistical data and laboratory procedure during internal/external clients; through this quality assurance auditor from Boeing frequently brought their external auditors for site visits as a showcase.

EDUCATION

Bachelor of Arts in Chemistry
University of Washington—Seattle, WA
Associate in Arts, Honors
Peninsula College—Port Angeles, WA

Nhon Luu

Profile

Mr. Nhon Luu has worked at Analytical Resources, LLC since 2010. Currently working in the Dioxin Prep Laboratory.

Education

1987 Graduated from High School- Curlew, Wauconda Washington.

Experience

2012-Present: Dioxin Lab Tech.
2010-2012: Extraction Lab Tech.

Appendix B

Training

Qualification Requirements

In addition to on-the-job training, ARLLC recommends a specific level of education and experience for the following positions:

GC/MS Laboratory Supervisor

A Bachelor's degree in chemistry or scientific/engineering discipline, three years' experience operating GC/MS systems and one-year supervisory experience.

GC Laboratory Supervisor

A Bachelor's degree in chemistry or scientific/engineering discipline, three years' experience operating GC systems and one-year supervisory experience.

Sample Preparation Laboratory Supervisor

A Bachelor's degree in chemistry or scientific/engineering discipline, three years' experience in organic sample preparation and one-year supervisory experience.

Data Systems/LIMS Manager

A Bachelor's degree with four or more computer-related courses and three years' experience in systems management or programming. A minimum of one year experience with software utilized for laboratory report generation is also recommended.

Programmer Analyst

A Bachelor's degree with four or more computer-related courses and two years' experience in systems or application programming. A minimum of one-year experience with software utilized for laboratory report generation is also recommended.

Quality Assurance Manager

A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

Project Manager

A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

GC/MS Chemist

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one-year experience operating a GC/MS system. Three years of GC/MS operations and spectral interpretation experience may be substituted in lieu of educational requirements.

Mass Spectral Interpretation Specialist

A Bachelor's degree in chemistry or a scientific/engineering discipline and participation in training course(s) in mass spectral interpretation. Also, at least two years of experience in mass spectral interpretation is recommended.

Purge and Trap Expert

A Bachelor's degree in chemistry or a scientific/engineering discipline and one-year experience operating a purge and trap type liquid concentrator interfaced to a GC/MS system.

GC Chemist

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one-year experience operating a GC system. Three years of GC operations and maintenance experience may be substituted in lieu of educational requirements.

Pesticide Analysis Expert

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one-year experience operating a GC system. Three years of GC operations and spectral interpretation experience may be substituted in lieu of educational requirements.

ICP Spectroscopist

A Bachelor's degree in chemistry or a scientific/engineering discipline and Four years of applied experience with ICP analysis of environmental samples. Four years of ICP experience may be substituted in lieu of educational requirements.

ICP Operator

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining ICP instrumentation. Three years of ICP experience may be substituted in lieu of educational requirements.

Atomic Absorption (AA) Operator

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining graphite furnace and cold vapor AA instrumentation. Three years of AA experience may be substituted in lieu of educational requirements.

Conventionals (Classical Chemistry) Analyst

A Bachelor's degree in chemistry of a scientific/engineering discipline and one year of experience with classical chemistry procedures. Three years of classical chemistry experience may be substituted in lieu of educational requirements.

Sample Preparation Expert

A high school diploma and one college level course in chemistry. One year of experience in sample preparation is also recommended.

Appendix C

Laboratory Facilities

ANALYTICAL RESOURCES LLC. occupies a total of 23,500 square feet of floor space located at 4611 S. 134th Place in Tukwila, Washington. The laboratory facility, constructed between September 2001 and June 2002, includes:

- State-of-the-art heating, ventilation and air conditioning (HVAC) systems to ensure a clean comfortable working environment while maintaining air flow balance designed to minimize the possibility of sample cross contamination between laboratory areas.
- A central service area provides space for five walk-in coolers (356 ft^2 total), and a small walk-in freezer, metals archive storage, and sample cooler storage. A 400 ft^2. walk-in freezer covered by a mezzanine for dry storage was added in 2005.
- A data network linking all workstations to a centralized server room. All connections are made to managed switches and hubs and are protected by the latest firewall technology and uninterruptible power supplies.
- Distribution systems to deliver pressurized Air, Zero Grade Air, Argon, Helium, Hydrogen, Nitrogen and to the laboratory areas from a central location.
- A system to deliver ASTM Type 1 water directly to sinks in each laboratory area. Water is purified by filtration, ion exchange and reverse osmosis and continuously re-circulated through a filtration + ion exchange + UV radiation polishing loop that delivers water directly to the laboratories.
- An isolated and ventilated hazardous waste storage area.
- An electronic repair shop and storage room.
- Alarm monitored fire sprinkler and intrusion detection systems

The facilities are divided into five functionally-distinct sections as detailed below:

1) The Organics Division features three main laboratory areas as described below:
   - The Organics Extraction Laboratory (2400 ft^2.) is utilized to isolate and concentrate organic compounds from various environmental sample matrices. The laboratory contains approximately 200 linear feet of bench space and nine fume hoods. It is equipped with two gel permeation chromatographs, an accelerated solvent extractor (ASE) and a gas chromatograph for extract screening purposes. The laboratory includes a separate area for extraction of aqueous samples, a glassware cleaning area and individual workstations for the laboratory supervisor and analyst.
   - The Semivolatile Organics Analysis Laboratory (3000 ft^2) has 124 linear feet of instrument bench space plus personal workstations. The Laboratory is equipped with seven Gas Chromatographs (GCs) with six GC-MS instruments, one High Resolution GC/MS (HRGC-MS) and a fume hood for preparation of standard solutions and dilution of samples. Each gas chromatograph is individually vented to the outside for removal of heat and potentially contaminated GC exhaust gases.
   - The Volatile Organics Analysis (VOA) Laboratory (2500 ft^2) houses seven GC-MS and two GC-PID instruments dedicated to volatile organics analysis. Each instrument is vented to the outside. The laboratory area includes two fume hoods, a sample/standards preparation area, a TCLP preparation/tumbler room and sample holding refrigerators. The HVAC system maintains a positive air pressure in the laboratory using filtered air from outside of the building. This eliminates the possibility of cross contamination of samples with solvents from other areas of the laboratory.

2) The Inorganic Division includes a Trace Metals Laboratory and the Conventional Analyses Laboratory:
   - Trace Metals Laboratory (3000 ft^2)
     - The Metals Preparation Laboratory (1200 ft^2) contains four 8-foot polypropylene fume hoods. An additional eight-foot polypropylene laminar flow fume hood is housed in a separate Class 1000 clean room. The lab is equipped with tumblers, hot-plates, digestion blocks, facilities for glassware cleaning, and two spectrophotometers for cold vapor analysis of mercury, a TCLP tumbler room, and storage areas.
     - The Metals Instrument Laboratory (1300 ft^2) features two inductively coupled argon plasma spectrometers (ICP) for simultaneous analysis of metals species, and two ICP-mass spectrometers for analysis of metals species at low detection levels.
     - A 500 ft^2. Office provides desk area for Trace Metals laboratory personnel.
   - The Conventional Analyses (Wet Chemistry) Laboratory (2500 ft^2) contains approximately 200 linear feet of bench space, eight fume hoods and includes a separate microbiology lab. Instruments in this lab include two Rapid-Flow Analyzers, two TOC analyzers, two ion chromatographs, two uv/visible spectrophotometers, and various other equipment necessary for the evaluation of inorganic parameters.

3) The Sample Receiving Facility consists of an area to accept and log-in samples to ARLLC's Laboratory Information Management System (LIMS) and an area to prepare and ship sampling supplies.
   - The Sample Receiving Facility (1000 ft^2) is equipped with two fume hoods, and 70 feet of bench space. Four computer terminals are available to log samples into ARLLC's LIMS.
   - The Sampling Containers Facility (500 ft^2) is used to prepare sampling containers for shipment to ARLLC's client designated locations.

4) Administrative Areas (8600 ft^2) include:
   - The Quality Assurance Section
   - Executive Offices
   - Project Management Section
   - The Human Resources Section
   - The Information Technology Section (previously 'Computer Services')
   - One Conference Room
   - A Lunch Room
   - Several Storage Areas

Appendix D

Laboratory Instrumentation And Computers

LABORATORY INSTRUMENTATION and COMPUTERS

Organic Extractions Laboratory Equipment

(MARS 3) CEM MARS™ (2011) – Microwave extraction apparatus.

(MARS 6) CEM MARS™ (2019) – Microwave extraction apparatus.

(MARS 6) CEM MARS™ (2019) – Microwave extraction apparatus.

(GPC 1) Varian Prostar 410 – Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 26 position autosampler used for clean-up of samples prior to final analysis.

(GPC 2) Varian Prostar 410 – Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 26 position autosampler used for clean-up of samples prior to final analysis.

(GPC 3) Varian Prostar 410 – Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 26 position autosampler used for clean-up of samples prior to final analysis.

Zymark Turbo-Vap LV (1999) - 24 place

Zymark Turbo-Vap LV (2002) - 24 place

Zymark Turbo-Vap LV (2007) - 24 place

Biotage Turbo-Vap II (2014) – 6 Place

Zymark Rapid Trace Solid Phase Extraction Workstations (2007) - 13 each

Dioxin Extractions Laboratory Equipment

Zymark Turbo-Vap LV (2010) - 24 place

Rotovap R-205 with V-805 Vacuum Controller (2010) – 2 each

Glas-Col Combo Heating Mantle (2010) – 6 place – 3 each

Vacuum Manifold – 6Place (2010) – for SPE

Gas Chromatograph - High Resolution Mass Spectrometer (GC/HRMS)

(HR1) Waters Autospec Premier (2009) – An HRGC-HRMS system with Masslynx Version 4.1 data acquisition & quantitation software. System includes an Agilent 7890A GC and 7683B autosampler.

(HR2) Waters Autospec Ultima (2015) – An HRGC-HRMS system with Masslynx Version 4.1 data acquisition & quantitation software. System includes an Agilent 6890 GC and 7683B autosampler.

Gas Chromatograph - Mass Spectrometers (GC/MS)

(NT2) Hewlett Packard (1999) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. System includes Agilent 6890 GC, 5973 MSD, a Teledyne Tekmar Atomx Purge and Trap for VOA analysis of aqueous or solid samples.

(NT3) Hewlett Packard (1999) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. System includes an HP 6890 Plus GC, an HP 5973 MSD, an OI Analytical Eclipse 4660 and a Varian Archon autosampler for VOA analysis of aqueous or solid samples.

(NT5) Hewlett Packard (2002) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system is equipped with an HP 6890N GC, an HP 5973N MSD, a Teledyne Tekmar Atomx Purge and Trap for VOA analysis of aqueous or solid samples.

(NT6) Hewlett Packard (2002) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an HP 6890 Plus GC, an HP 5973 MSD and an HP 7683 autosampler.

(NT7) Hewlett Packard (2007) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system is equipped with an HP 6890 GC, an HP 5973N MSD, a Varian Archon autosampler and Tekmar Stratum.

(NT8) Agilent (2008) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system is equipped with Agilent 6890N GC, 5975C MSD, and 7683 autosampler.

(NT10) Agilent (2008) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system is equipped with Aglient 6850 GC, an Agilent 5975C inert MSD and an Agilent 6850 autosampler.

(NT11) Hewlett Packard (2009) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 6890 N GC, an HP 5973N MSD and an HP 7683 autosampler.

(NT12) Hewlett Packard (2011) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes a Hewlett-Packard 6890 GC, an HP 5973N MSD and an HP 7683 autosampler.

(NT14) Hewlett Packard (2014) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 7890A GC, an HP 5975C Inert MSD and an HP 7683 autosampler.

(NT15) Hewlett Packard (2014) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 6850 GC, an HP 5975C MSD and a Teledyne Tekmar Atomx Purge and Trap for VOA analysis of aqueous or solid samples.

(NT16) Agilent (2015) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 7890B GC, an Agilent 5977A MSD and a Teledyne Tekmar Atomx Purge and Trap for VOA analysis of aqueous or solid samples.

(NT17) Agilent (2020) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 7890B GC, an Agilent 5977B MSD and an Agilent 7693A autosampler.

Gas Chromatographs

(OE-GC1) Hewlett Packard 5890 Series II (2003) – A GC system equipped with both FID and ECD detectors, capillary injectors, an autosampler and ChemStation. Used for screening samples before full extraction.

(OE-GC2) Hewlett Packard 6890 Series II (2014) – A GC system equipped with both FID and ECD detectors, capillary injectors, an autosampler and ChemStation. Used for screening samples before full extraction.

(FID3A, B) Hewlett Packard 6890 (1996) – A GC system equipped with dual FID detectors, two capillary injectors, a dual tower HP 6890 autosampler, and Agilent ChemStation data system.

(FID4A, B) Hewlett Packard 6890 (1996) – A GC system equipped with dual FID detectors, two capillary injectors, a dual tower HP 6890 autosampler, and HP ChemStation data system.

(PID 1) Hewlett Packard 5890 Series II – (2006) –A GC system equipped with PID and FID detectors in series, a Teledyne Tekmar Atomx sample concentrator and HP ChemStation data system.

(ECD5) Hewlett Packard 6890 (2002) – A GC system equipped with dual µECD detectors, an HP 7683 autosampler and an HP ChemStation data system.

(ECD6) Hewlett Packard 6890 P (2008) – A GC system equipped with dual µECD detectors, an Agilent 6890 autosampler and an HP ChemStation data system.

(FID6) Hewlett Packard 5890E Series II (2008) – A GC system equipped with dual FID detectors, an HP 7694 headspace autosampler and HP ChemStation data acquisition system.

(FID7) Agilent 6850 (2008) – A GC system equipped with a single FID detectors, an Agilent 6850 autosampler and HP ChemStation data acquisition system.

(ECD7) Hewlett Packard 6890 (2008) – A GC system equipped with dual µECD detectors, an Agilent 6890 autosampler, and HP ChemStation data system.

(ECD8) Hewlett Packard 6890N – (2011) – A GC system equipped with dual µECD detectors, an Agilent 7683 autosampler, and HP ChemStation data system.

(FID8) Agilent 6890N (2008) – A GC system equipped with dual FID detectors, an Agilent 7683B autosampler and HP ChemStation data acquisition system.

(ECD9) Hewlett Packard 7890 – (2015) – A GC system equipped with dual µECD detectors, an Agilent 7693 autosampler and an HP ChemStation data system.

Inorganic Instrumentation

Perkin-Elmer Nexlon 300D ICP-MS (2011) - A completely automated reaction cell & collision cell ICP-Mass Spectrometer with Elemental Scientific SC-2 Fast autosampler and multitasking software.

Perkin-Elmer Nexlon 350D ICP-MS (2015) - A completely automated reaction cell & collision cell ICP-Mass Spectrometer with Elemental Scientific SC-2 Fast autosampler and multitasking software.

Perkin-Elmer Optima 7300DV ICP (2009) – Automated dual view simultaneous ICP with an Elemental Scientific SC-2 Fast autosampler system

Perkin-Elmer Optima 4300 ICP (2001) - A completely automated dual view simultaneous ICP with auto-sampler and multitasking software.

CETAC M-6000A Mercury Analyzer (2000) – A fully automated high sensitivity cold vapor atomic absorption instrument dedicated to trace and ultratrace Mercury analysis. System is computer controlled with windows base software and an auto-sampler.

Leeman Labs Hydra II Mercury Analyzer (2016) – A fully automated high sensitivity cold vapor atomic absorption instrument dedicated to trace and ultratrace Mercury analysis. System is computer controlled with windows base software and an auto-sampler.

Dionex Ion Chromatography DX 500 (1997) – A fully automated system with an auto-sampler for quantitative anion analyses. The system is computer controlled using Peaknet software.

Dionex Ion Chromatography 2100 (2009) – A fully automated system with an auto-sampler for quantitative anion analyses. The system is computer controlled using Chromeleon CHM-2 Version 7.0 software.

Shimadzu UV1800 (2016) - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

Shimadzu UV1800 (2016) - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

Lachat QuickChem 8000 Flow Injection Analyzer (2003) – Automated flow injection instrument dedicated to low level nutrient analysis

Lachat QuickChem 8500 Flow Injection Analyzer (2007) – Automated flow injection instrument dedicated to low level nutrient analysis

Dohrmann Apollo 9000 (2009) - Total Organic Carbon (TOC) Analyzer, including a boat sampler for solids analysis.

Shimadzu TOC-LCSH (2014) - TOC analyzer with autosampler for aqueous samples.

TOC Cube (2018) – TOC analyzer for soil samples.

Accumet AR60 (2013) - pH Meter

Accumet XL60 (2011) – ISE/pH Meter

ORION Model 115 (2010) – Conductivity Meter

ORION 5 Star (2014) – RDO Meter

Hach Ratio 2100N - Turbidimeter

Kontes Midi-Vap Cyanide Distillation Systems (3 each)(1995-2008) – Each of the systems is capable of simultaneously distilling up to 10 samples for cyanide analysis using small sample aliquots.

Centrifuge (1987) - Beckman Model GP with swinging bucket rotor and inserts for 250 ml bottles and scintillation vials

Aim 600 Block Digestion System (2006) with Controller

Environmental Express Hot Block digestion blocks (10 ea.) (1999-2008) for digestion of samples prior to trace metals analysis.

Hach COD Digestion Blocks (2 each)

Incubators: VWR Model 2020 (2each) BOD incubator
Precision Model 2860 Coliform Incubator Oven
Precision Model 2862 Coliform Incubator Oven
Thermolyne Coliform Water Bath Incubator

Network Infrastructure

ARLLC has a Windows Active Directory network that handles all user authentication, access control, and services. User profiles are created on the AD server and permissions are assigned per roles and responsibilities and group and user levels. The primary server combines three virtual machines, each one individually handling database, file, and LDAP services. The stack is managed through a HyperV hypervisor. The entire stack is backed up locally, with incremental snapshots taken every 30 minutes daily and a full synchronization every morning. The full synchronization is pushed to a cloud storage service, Datto, for secure, offsite storage. ARLLC uses Key Methods for additional IT support outside the scope of internal staff.

ARLLC uses Element, developed by Promium, as a Laboratory Information Management System. All data related to sample control, preparation, analysis, reporting, and business operations are retained on this system. User profiles, separate from those on the domain, are used to control access to the different functions of the application and users can be granted read/write permission as needed to fulfill their duties. The application is fully supported by Promium and administrative users have access to the staff engineers. ARLLC employs a full-time Element developer to build reports and queries needed for reporting data to end users and implementing controls and processes needed for operational flow. Most changes, including additions and deletions, in Element are audited and can be reviewed by management.

Office 365 hosting is used for all e-mail, messaging, and file sharing services. It's centrally managed by ARLLC IT staff and has a full suite of access control and auditing tools. General lab documentation is controlled via the SharePoint application of Office 365, allowing for document control and versioning.

All servers are secured in a locked room where only management and IT staff have access. Some users have external access to the network but this is limited to current employees and only through an end-to-end encrypted VPN service, NetCloud.

Note: Extensive in-house replacement parts are available for lab instruments and computers, including spare circuit boards. A majority of all service maintenance is performed by ARLLC employees.

Appendix E

Analytical Methods

ORGANIC ANALYSES

Parameter	Methods	Technique
Volatiles (GC/MS)	524.3/624/8260	CGC/MS
	Low Level Vinyl Chloride & 1,1 – Dichloroethene	GC-MS-SIM
Volatiles (GC)		
Volatile Aromatics	602/8021B (No longer active)	GC/PID
Semivolatiles (GC/MS)		
Semivolatile Organics	625/8270D	GC/MS
Polynuclear Aromatic	Hydrocarbons (PNA/PAH) GC/MS-SIM	625/8270D
Butyl Tin Species	Krone (1988)	GC/MS-SIM
Pesticides/GC Analyses		
Chlorinated Pesticides	608/8081A	GC/ECD
Aroclors/PCBs	608/8082	GC/ECD
PCB Congeners	ARLLC Method	GC/ECD
Phenols	604/8041	GC/FID
Chlorinated Phenols	8041 (mod)	GC/ECD
Pentachlorophenol	8151A (mod)	GC/ECD
Organophosphorous Pesticides	614/8141A	GC/NPD
Chlorinated Hydrocarbons	612/8121	GC/ECD
Glycols	ARLLC Method(SOP 426S R2)	GC/FID
Hydrocarbon ID	NWTPH-HCID	GC/FID
Gasoline Range Hydrocarbons	(N)WTPH-G/AK101/WI-GRO	GC/FID
Diesel Range Hydrocarbons	(NWTPH-D/AK102/WI-DRO)	GC/FID
Extractable Petroleum Hydrocarbons	WDOE 6/1997	GC/FID
Volatile Petroleum Hydrocarbons	WDOE 6/1997	GC/PID
Organic Sample Preparation and Clean Up		
TCLP / SPLP Extraction		1311 / 1312
Sonication		3550B
Soxhlet		3540C
Accelerated Solvent Extraction (ASE)		3545B
Separatory Funnel		3510C
Continuous Liquid-Liquid		3520C
Alumina Clean-up		3610B
Florisil	Clean-up	3620B
Gel Permeation (GPC)		3640A
Silica Gel		3630C
Sulfur Clean-up		3660B
Sulfuric Acid Clean-up		3665A

INORGANIC ANALYSES

Parameter	Methods	Technique
Wet Chemistry		
Acidity	2310/305.1	Titrimetric
Alkalinity	2320/310.1	Titrimetric
Ammonia	4500NH_3H/350.1	AutomatedPhenate/ISE
Biological Oxygen Demand-BOD		
Carbonaceous – BOD	5210.B/405.1	5-day Winkler Titration
Bromide	4500Br.B	Phenol Red Colorimetric
Anions	300.0	Ion Chromatography
Cation Exchange Capacity	9080	Neutral Ammonium Acetate
Chemical Oxygen Demand	5220.D/410.4	Closed Reflux, Colorimetric
Chromium Hexavalent (Cr6+)	3500Cr-D/7196A	Diphenylcarbazide
Chloride	4500Cl.E/325.2	Automated Ferricyanide
Coliform, Total / Fecal	9222.B/D	Membrane Filtration
Color	2120.B/110.2	Visual Comparison
Conductivity	2510/120.1	Electrometric
Corrosivity (CaCO3 Saturation)	2330	Calc. (pH, Alk, TDS, Ca)
Cyanide, Total	4500CN.C/335.2/9010	PBA, Colorometric
Cyanide, Amenable	4500CN.G/335.1	Alkaline Chlorination
Cyanide, WAD	4500CN.I	Weak Acid Distillation
Dissolved Oxygen	4500-O.C/360.2	Winkler Titration
Fats/Oils/Grease	5520.B/413.1/9070A	Gravimetric
Fluoride	4500F.C/340.2	Ion Specific Electrode
	300.0	Ion Chromatography
Hardness, Calculation	2340.B/6010B	Ca, Mg Calculation
Heterotrophic Plate Count	9215.D	Membrane Filtration
Iron (II) ferrous	3500Fe.D	Phenanthrolene
Nitrate + Nitrite	4500NO_3F/353.2	Automated Cd Reduction
Nitrate	4500NO_3F/353.2	Calculated
	300.0	Ion Chromatography
Nitrite	4500NO_3.F/353.2mod	Automated Colorimetric
	300.0	Ion Chromatography
Oil & Grease, Solids	5520.D/907	Gravimetric
Oil & Grease, Polar/Non Polar	5520.F	Gravimetric
PH	150.1	Electrometric
Phenols	5530.D/420.1/9065	4-AAP w/ Distillation
Phosphorous, Total	4500P.B/365.2	Colorimetric w/ digestion
Phosphorous, Ortho (SRP)	4500P.B/365.2	Colorimetric
	300.0	Ion Chromatography
Salinity	2520	Conductimetric
Total Kjeldahl Nitrogen (TKN)	4500N.org/351.4	Block Digest/ISE
Total Solids	2540.B/160.3	Gravimetric, 104°C
Total Suspended Solids (TSS)	2540.D.160.2	Gravimetric, 104°C
Total Dissolved Solids (TDS)	2540.C/160.1	Gravimetric, 180°C

Total Volatile Solids (TVS)	2540.E/160.4	Gravimetric, 550°C
Settleable Solids	2540.F	Volumetric
Streptococcus, Fecal	9230.C	Membrane Filtration
Sulfide	4500S^2 E / 376.1/9034	Iodometric
Sulfide, Low Level	4500S^2 D / 376.2	Methylene Blue
Sulfide, Acid Volatile	4500S^2 D / 376.2	Methylene Blue
Sulfate	4500SO_4^2.F / 375.2 / 9036	Auto. Methylthymol Blue
	300.0	Ion Chromatography
Sulfite	4500SO_3^2.B.377.1	Iodometric
Total Organic Carbon (TOC)	5310 B / 415.1 / 9060A,PSEP	Combustion NDIR
Turbidity	2130.B / 180.1	Nephelometric
Total Lipids in Tissue	Bligh & Dyer (mod)	Gravimetric

Trace Metals Analyses

Inductively Coupled Plasma (ICP):

Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, Th, Ti, Tl, V, Zn (Li, Th, U, W - special request only)	200.7 / 6010B	ICP

Cold Vapor (CVAA):

Hg	7470A / 7471A	CVAA

Inductively Coupled Plasma/Mass Spectroscopy (ICP-MS):

Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Th, Tl, U, V, Zn	200.8/ 6020 Mod.	ICP/MS

Trace Metals Sample Preparation

Toxicity Characteristic Leaching Procedure	1311
Synthetic Precipitation Leaching Procedure	1312
Digestion for Total Recoverable or Dissolved Metals	3005A
Digestion of Aqueous Samples for Total Metals by ICP	3010A
Digestion of Aqueous Samples for Total Metals by GFAA	3020A
Digestion of Sediment, Sludge and Soil	3050B

Appendix F

Laboratory Accreditations

The National Environmental Laboratory Accreditation Program (NELAP), the State of Washington Department of Ecology and the State of Alaska Department of Environmental Conservation currently certify Analytical Resources Inc. to perform environmental analysis.

ARLLC is approved to perform analyzes for the United States Department of Defense (DoD) agencies following the DoD Quality Systems Manual (DoD-QSM)

The Boeing Company and Battelle Pacific Northwest Laboratories have audited and approved ARLLC's laboratory QA/QC Program

ARLLC analyzes drinking water, wastewater and solid matrix performance testing (PT) samples for all accredited methods semiannually.

List of Accreditations

1) National Environmental Laboratory Accreditation Conference (NELAC) – Accrediting authority is Oregon Environmental Laboratory Accreditation Program (ORELAP).
2) State of Washington, Department of Ecology - Environmental Laboratory Accreditation Program
3) The Alaska State Department of Environmental Conservation - Laboratory Approval Program
4) United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP) Administered by Perry Johnson Laboratory Accreditation (PJLA).
5) The State of California Environmental Laboratory Accreditation Program (CA-ELAP)

Continuing Contracts Resulting from On-Site Laboratory Audits

1) The Boeing Company Corporate Environmental Affairs Division
2) The City of Seattle
3) The Port of Seattle

Appendix G

Data Reporting Qualifiers

Data Reporting Qualifiers

Effective 7/10/2009

Inorganic Data

U	Indicates that the target analyte was not detected at the reported concentration
*	Flagged value is not within established control limits
B	This analyte was detected in the method blank
CONF	Confluent growth
N	Matrix Spike recovery not within established control limits
NA	Not Applicable, analyte not spiked
H-	The natural concentration of the spiked element is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible
L	Analyte concentration is ≤5 times the Reporting Limit and the replicate control limit defaults to ±1 RL instead of the normal 20% RPD
TNTC	Too numerous to count
W	Weight of sample in some pipette aliquots was below the level required for accurate weighing

Organic Data

*	Flagged value is not within established control limits
A	The reported TIC is a suspected aldol-condensation product
B	This analyte was detected in an associated Method Blank
C	The identification of the analyte is confirmed by GC/MS when the primary analytical method employed is GC/ECD as appropriate
C	The analyte was positively identified on only one of two chromatographic columns. Chromatographic interference prevented a positive identification on the second column
D	The reported value is from a dilution
D1	Surrogate was not detected due to sample extract dilution

E- Estimated concentration calculated for an analyte response above the valid instrument calibration range. Dilution of the sample or extract is required to obtain valid quantification of the analyte.

EMPC Estimated Maximum Possible Concentration (EMPC) defined in EPA Statement of Work DLM02.2 as a value "calculated for 2,3,7,8-substituted isomers for which the quantitation and /or confirmation ion(s) has signal to noise in excess of 2.5, but does not meet identification criteria" **(Dioxin/Furan analysis only)**

F Samples were frozen prior to particle size determination

H Hold time violation – Hold time was exceeded

HC The natural concentration of the spiked analyte is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible

HT The reported value is quantitated using peak heights rather than peak areas

J- Estimated concentration when the value is less than ARLLC's established reporting limits

L Analyte concentration is <= 5 times the reporting limit and the replicate control limit defaults to +/-RL instead of 20% RPD

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters. This flag is used only for GC-MS analyses

N The reported TIC has a >= 80% match on the mass spectral library search

NRS This surrogate not reported due to chromatographic interference

P The reported value is greater than 25% difference between the concentrations determined on two GC columns where applicable

P1 The analyte was detected on both chromatographic columns but the quantified values differ by ≥40% RPD with no obvious chromatographic interference

PC Preservation was checked and failed

Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20% RSD, <20% Drift or minimum RRF).

S The reported value is determined using a single-point ICAL by GC/ECD analytical method as appropriate

SM Sample matrix was not appropriate for the requested analysis. Normally refers to samples contaminated with an organic product that interferes with the sieving process and/or moisture content, porosity, and saturation calculations

SS Sample did not contain the proportion of “fines” required to perform the pipette portion of the grainsize analysis

T The total of all fines fractions. This flag is used to report total fines when only sieve analysis is required, and balances total grainsize with sample weight

U Indicates that the target analyte was not detected at the reported concentration

Text1 Custom value

X Analyte signal includes interference from polychlorinated diphenyl ethers. **(Dioxin/Furan analysis only)**

X Custom value

Y The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

Y Custom value

Y1 Raised reporting limit due to interference

Z Analyte signal includes interference from the sample matrix or perfluorokerosene ions. **(Dioxin/Furan analysis only)**

Z Custom value

Appendix H

Standards for Personal Conduct

Standards of Conduct

Since effective working relationships depend upon each of us, ARLLC expects certain minimum standards of personal conduct.

This list highlights general ARLLC expectations and standards and does not include all possible offenses or types of conduct that may result in discipline or discharge. Management reserves the absolute right to determine the appropriate degree of discipline, including discharge, warranted in individual cases.

Employees engaged in the following activities, or similar activities, may be terminated:

- theft or embezzlement
- disclosure of trade secrets or industrial espionage;
- willful violation of safety or security regulations;
- conviction of a felony;
- working for a competitor or establishing a competing business.

In addition, dismissal may result from other serious offenses such as:

- being intoxicated, under the influence or in possession of illegal drugs on the job;
- falsification of records;
- abuse, destruction, waste or unauthorized use of equipment, facilities or materials;
- gambling on the premises;
- chronic tardiness or absenteeism;
- insubordination;
- unwillingness to perform the job;
- unauthorized requisition of materials from vendors.

There may be no alcoholic beverages consumed on ARLLC premises, other than at times designated as Company functions, at which non-alcoholic beverages will also be provided.

Personal and corporate honesty and integrity have built the character of ARLLC. This good character is fundamental to our well-being, future growth and progress. It is vitally important that we avoid both the fact and the appearance of conflicts of personal interest with that of the firm, its clients, and any other professional contacts.

This policy requires that ARLLC employees have no relationships or engage in any activities that might impair their independence of judgment. Employees must not accept gifts, benefits, or hospitality that might tend to influence them in the performance of their duties. It is expected

that there will be no employment by any competing company, nor any employment by any outside interest or engagement in outside activity which might impair an employee's ability to render the full-time service to the company that employment involves.

If any possible conflict of interest situation arises, the individual concerned must make prior disclosure of the facts so that action may be taken to determine whether a problem exists and, if so, how best to eliminate it. Likewise, any financial interest in an organization doing business with ARLLC or which competes with us should be revealed to Company management. (Excluded from this requirement is ownership of securities traded in major stock exchanges or other recognized trading markets.)

Our standards are those generally expected of employees in any well-regarded, ethical business organization.

ARLLC further expects that each employee will:

- Be dressed and groomed appropriately for a business office. Employees in the laboratory areas are expected to dress in compliance with established safety procedures. Specific standards will be discussed with each employee during Health and Safety orientation. Your supervisor and the Administrative Services Manager always are available to answer questions.
- Maintain the confidential nature of Company information. Removal of Company documents, records, stored materials, computer printouts, or any similar information, or copies of such material or information from the office without specific permission is prohibited. Likewise, revealing confidential information to an unauthorized person or using such information in an unauthorized way is prohibited. If there could be any possible question about the applicability of this requirement to a given circumstance, ask your supervisor.
- Use Company computer capabilities and facilities only for authorized business at authorized times and locations; observe strictly all computer security measures and precautions; enter, alter or delete no computer instructions or stored material apart from that required by faithful performance of assigned duties; remove, copy, use or permit to be used no computer software developed for, purchased by, or otherwise used by ARLLC except as required by faithful performance of assigned duties.
- Conduct business dealings with clients and members of the public in a courteous manner.

Appendix I

Quality Assurance Policies

Quarterly QA Tasks

Year: _____ Quarter _____

- ☐ Logbook Review
- ☐ Balances
- ☐ Pipette Verifications
- ☐ Dispenser Verifications
- ☐ Sash-hood Flow
- ☐ ThermoLogger Verification
- ☐ Oven Electronic Thermometers
- ☐ IR Thermometers
- ☐ Fluke and Oakton Thermometers (for all ranges)
- ☐ Liquid Thermometers (annual only, Qtr. 4)
- ☐ Ethics and Haz Waste Training (annual only, use attendance form 12206F)
- ☐ DoD Management Review (12207F, annual only: Qtr. 4)
- ☐ TCLP Tumbler RPM Check
- ☐ Audit Sections for Posted Obsolete Operator Aids
- ☐ QA Orientation (as needed)
- ☐ Client Feedback Review
- ☐ Project Completeness Review (10% of QSM5.1 Projects)
- ☐ Log MDL jobs (Metals, Dioxins, VOAs, 524.3)
- ☐ Compile MDL Workorder Results
- ☐ Control Chart Review for Trends (QSM5.1-1.7.3.2.3.d)
- ☐ Update MDLs/LODs/LOQs and CLs (annual Qtr. 1) in Element
- ☐ IDOC/DOC Training Records Review
- ☐ Test Methods (see schedule)
- ☐ Standards Review for CofA
- ☐ Add MRL/LOD Data for Previous Qtr (2-yrs max)
- ☐ Add Intra-Lab PT Tracking Data for Previous Quarter
- ☐ Update Accreditation Locations (if necessary: checklist 12201F)

Review all audit forms for completeness prior to archiving in: *SharePoint/ARI QA/Internal Audits Library*

ARLLC Annual Test-Methods and non-Technical Audit Schedule

Quarter 1:

- ☐ Microbiology
- ☐ Color
- ☐ Cyanide
- ☐ Ammonia, Auto
- ☐ Ammonia, ISE
- ☐ COD
- ☐ TOC
- ☐ Lachat
- ☐ Sulfide
- ☐ Gravimetric (Solids, Oil/Grease)

Quarter 2:

- ☐ Colormetric
- ☐ IC
- ☐ Probe (BOD, pH , Conductivity, Salinity)
- ☐ Alkalinity
- ☐ ICP
- ☐ ICPMS
- ☐ CVAA

Quarter 3:

- ☐ Chlorinated Pesticides
- ☐ Dioxins/Furans
- ☐ PCBs
- ☐ Petroleum Hydrocarbons
- ☐ Requests, Tenders, and Contracts (e.g., subcontractor accreditations)
- ☐ Services to the Client

Quarter 4:

- ☐ Organics Extraction Lab
- ☐ SVOA
- ☐ SVOA - SIM
- ☐ VOC
- ☐ VOC – SIM
- ☐ Purchasing Services and Supplies
- ☐ Recommendations for Improvement
- ☐ Complaints

QUALITY ASSURANCE POLICY

POLICY NUMBER: 1

SUBJECT: CORRECTIONS TO DATA/BENCHSHEETS

DATE: 8/2/96

Manual corrections made on any raw data, bench sheet, logbook or document used during sample processing will be made in the following manner:

1. Draw a single line through the information to be deleted or corrected. The original information must remain readable.

2. Enter any new information, preferably above the original information.

3. Initial and date the correction.

QUALITY ASSURANCE POLICY

POLICY NUMBER: 2

SUBJECT: LINING OUT UNUSED BENCHSHEET PORTIONS

DATE: 8/2/96

All unused portions of logbook pages and benchsheets will be lined through so that information cannot be added at a later date. This will be completed in the following manner:

1. Line out unused portions of a logbook page or benchsheet by drawing a single line or "Z" through the unused portions.

2. Initial and date the page beside the lineout.

3. Do not line out a page or section until it is certain that no additional information will be added to the unused portions.

QUALITY ASSURANCE POLICY

POLICY NUMBER: 3

SUBJECT: STOP WORK ORDERS

DATE: 8/28/96

It is the responsibility of all staff members to address situations that may require the issuance of a "stop work order". Potential and actual "stop work orders" will be handled as follows:

1. If an analyst or technician observes a situation which will or may have a negative impact on data quality, that person will notify her/his section supervisor immediately.

2. The section supervisor will assess the situation. If it appears that a "stop work order" may be required, the section supervisor will notify the appropriate manager (inorganic or organic).

3. The supervisor and manager will then decide if a "stop work order" should be issued. The manager will make a final decision on whether or not to issue a "stop work order". The incident will be reported to the Quality Assurance Program Manager using a Corrective Action Request form.

4. If a "stop work order" is issued, the manager will inform the Project Managers and the QA section. The section supervisor will notify section staff of the order.

5. The laboratory manager involved will oversee the development and implementation of a Corrective Action Plan (CAP). Upon completion of the CAP the "stop work order" may be rescinded.

6. Prior to rescinding a "stop work order", verification must be made that control has been regained and that work may begin. Only the inorganic or organic manager may rescind a "stop work order".

7. When the "stop work order" is rescinded, the Project Managers, analytical staff and QA section will be notified. The QA section will require documentation verifying that the procedure is back in control.

QUALITY ASSURANCE POLICY

POLICY NUMBER: 4

SUBJECT: SOP Review

DATE: 9/3/96

All Standard Operating Procedure (SOP) documents will be reviewed and updated at least annually by qualified staff members. Laboratory management will review and approve all modifications to the SOPs.

QUALITY ASSURANCE POLICY

POLICY NUMBER: 5

SUBJECT: Reporting Dilutions

DATE: 9/11/96

Dilution factors will be recorded as whole numbers followed by "X" (i.e., 5X, 10X, etc.). This reporting convention will be used on run logs, bench sheets, raw data and final reports for all diluted samples, extracts or digestates or standards.

QUALITY ASSURANCE POLICY

POLICY NUMBER: 6

SUBJECT: Formatting for SOPs – Computer Related

DATE: 1/31/00

Conventions for formatting computer-related instructions in SOPs

Commands should be indented and formatted as **bold courier** and one or two font sizes smaller:

```
USE PARAMS ORDER PARAMS
BROW
```

Many systems and languages are *case-sensitive*, and case should match the syntax and/or stylistic standards of the language.

If only one command, like ***SET CENTURY ON***, is needed, it can be included in the rest of the text, so long as it is also italicized.

If the user must substitute a particular value in place of a general descriptor, italicize the descriptor, make it lowercase, and *do not make it bold*:

```
USE PARAMS ORDER PARAMS
COPY TO TEMPARM FOR JOB = 'job' .AND. SAMPLE = 'sample'
```

In general, keywords, variable names, formatting codes, and descriptors should be in *courier* and *italicized*.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**7**
SUBJECT:	**Manual Adjustment of Data**
DATE of IMPLEMENTATION:	**1/1/01**

Modern chromatographic instruments include computer software to identify a detector response as a chromatographic peak, characterize that peak and determine the relative height or area of the signal. The software utilizes parameters (threshold, slope, etc) that are adjusted by the instrument operator to optimize the results.

A single set of operator controlled settings that determine peak characteristics for an entire data file is defined as an "automated procedure". An automated procedure often characterizes chromatographic peaks incorrectly. ARI requires that trained analysts identify and resolve these errors using an alternate automated procedure or a "manual adjustment" of the data. Manual adjustment is defined as the process used by an analyst to adjust an individual peak or a subset of data in a chromatographic file.

1. The settings for a routine automated procedure normally used to process chromatographic data must be described in the method Standard Operating Procedure (SOP).

2. Trained analysts may substitute one automated procedure for another in order to optimize peak characteristics. The use of an alternate automated procedure must be permanently documented using either a software generated log file or analyst notes.

3. Manual adjustment of chromatographic peak characteristics will be used to correct the results of an automated procedure that, in a trained analyst's opinion, are clearly incorrect and will result in erroneous peak identification, integration or quantification.

4. Manual adjustment will be implemented in a reasonable and consistent manner. Guidelines for performing manual adjustment will be documented in method SOPs.

5. All manually adjusted data will be clearly identified for approval in the data review process. A permanent record of all manual adjustments will be maintained in both electronic and hardcopy versions of the raw data.

6. Manual adjustment of chromatographic files will not be used to falsify data for any purpose. Falsification of data through the use of manual peak adjustment is unethical, unlawful and will result in termination of the offending analyst.

Approval:

_____

Quality Assurance Program Manager Date

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**8**
SUBJECT:	**Performance Testing Samples**
IMPLEMENTATION DATE:	**1/1/01 (Modified 11/12/18)**

As described in section 15.3 of the LQAP, Performance Testing (PT) samples will be analyzed on a periodic basis to monitor laboratory performance and/or meet the requirements of an external accreditation program. PT samples contain target analytes in concentrations unknown to laboratory personnel. PT samples are purchased from a third-party PT provider that sends graded PT results directly to ARI's Accrediting Bodies (ABs).

PT samples will be logged-in, prepared, analyzed and reported as a routine sample without special consideration.

When PT samples are not commercially available for individual analytes, analytical proficiency will be demonstrated using intra-laboratory comparisons. On a quarterly basis, Blank Spikes will be analyzed by multiple analysts and the data compiled and statistically evaluated to determine the laboratory's precision, accuracy, and z-scores for analyzing these method/matrix/analyte combinations.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**9**
SUBJECT:	**Modifications to Analytical Methods Procedures or Reports**
DATE of IMPLEMENTATION:	**8/24/05**

This Policy defines the processes used to initiate and validate modifications to analytical processes, QA/QC protocol, data processing programs and algorithms, data reporting formats or other changes to analytical procedures or SOPs at Analytical Resources, LLC. The procedures outlined will also be used to validate project specific changes to analytical protocol and new analytical methods.

Changes to analytical procedures must be approved by ARLLC's Management (Managers and/or Supervisors) and be well documented using the following procedure:

1. Modification may be requested by any staff member. The modification must be requested using ARLLC's Corrective Actions Tracking System. Corrective Action requests for changes to analytical protocol or reports will assigned to the appropriate manager or supervisor by the initiator. As an alternative the request may be assigned to the QA Section. The Corrective Actions assignee may approve the project or re-assign the request for approval to a third party. The QA Section will monitor the progress of all requests.

2. The requestor must detail and justify the proposed modifications or additions when initiating a Corrective Action issue. Modifications must be approved by ARLLC management prior to any work performed to establish the modification.

3. The following must be in place before final approval and/or implementation of the proposed modification.

A. A new or revised SOP as appropriate including the modification or new protocol.
B. An Initial Demonstration of Proficiency as defined in ARLLC SOP 1018S for new or modified analytical procedures.
C. An MDL study following the procedure in ARLLC SOP 1018S for new or modified analytical procedure.
D. When appropriate, successful analysis of a blind Performance Evaluation Sample using new or modified procedures or data processing protocol.
E. Documentation that new or modified software provides the desired result.

4. ARLLC staff must have sufficient training to implement the procedural changes.

5. Notification of the modifications must be distributed to all affected personnel including appropriate client personnel.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**10**
SUBJECT:	**Reporting of Target and Spiked Analytes For Dual Column GC Analyses**
DATE of IMPLEMENTATION:	**8/24/05**

Analytical Resources Inc. uses single injection, dual column gas chromatographs to simultaneously identify and confirm the presence of target or spiked analytes in some GC analyses. Only one quantitative value is reported for each target or spiked analyte. ARLLC's policy for deciding which value to report is outlined as follows:

1. ARLLC considers each column equally valid for compound identification and quantification. Both GC columns must be compliant with all quality assurance parameters outlined in ARLLC's SOPs and LQAP. Both GC columns must produce valid initial and continuing calibrations using the same calibration model.

2. The analytical value reported will be determined by comparison of the quantitative results of confirmed analytes as follows.

a. The relative percent difference (RPD) between the results on the two columns (R_1 & R_2) is calculated using the formula:

$$RPD = \frac{|R_1 - R_2|}{\left(\frac{R_1 + R_2}{2}\right)} \times 100$$

b. If the RPD is less than 40% the greater of the two values is reported for both target analytes and spiked compounds. When required by specific QA protocol, by contract or client request the lower value will be reported for target analytes.

c. If the RPD is greater than 40%, ARLLC's analyst must examine the chromatogram for anomalies (overlapping peaks, incorrect integration, negative peaks) and either correct the anomalies (i.e., perform manual integrations) or report the most appropriate target analyte value. The higher value will be reported for spiked analytes. ARLLC's analyst must provide a written evaluation of all analyses where an RPD exceeds 40% and this information must be passed on to ARLLC's client or the data user.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**11**
SUBJECT:	**Calculation of Analytical Uncertainty**
DATE of IMPLEMENTATION:	**8/31/06**

Analytical Resources Inc. will use the procedure[1] proposed by Thomas Georgian, PhD to estimate analytical uncertainty. Dr. Georgian's proposes using the formulae below to calculate uncertainty:

For biased corrected analytical results:

100 (c/R)(1± L / R)
Where:
c = Measured concentration of the analyte
R = Average Blank Spike recovery
L = ½ the warning or control range

And for unbiased results i.e., R = 100

c (± L / 100)

Example:

For a 10-ppb analytical result when the mean BS recovery is 50% and the control limits are 20% to 80% an interval for the analytical results is calculated as follows:

100 (10 ppb / 50)(1±30 / 50) = 20 ± 12 ppb

[1] Estimation of Laboratory Analytical Uncertainty Using Laboratory Control Samples, Thomas Georgian, Ph.D., *Environmental Testing & Analysis*, November/December 2000.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**12**
SUBJECT:	**Rounding of Numbers and Reporting Limits**
DATE of IMPLEMENTATION:	**6/10/14 (modifications proposed)**

I. ARLLC reports analytical results in concentration units as follows:

A. Values expressed as a concentration (mg/L, µg/Kg etc.) will be reported using 3 significant figures.

B. Values expressed as percent (control limits, RSD etc.) are reported using the appropriate whole number. Examples: 6.38 rounds to 6, 9.95 rounds to 10, 99.93 rounds to 100, 145.48 rounds to 145.

II. ARLLC rounds numbers to the appropriate level of precision using the following rules:

A. If the figure following those to be retained is greater than or equal to 5, the absolute value of the result is to be rounded up: otherwise, the absolute value of the result is rounded down. Examples: -0.4365 rounds to -0.437 and 2.3564 rounds to -2.356; 11.443 is rounded down to 11.44 and 11.455 is rounded up to 11.46.

B. When a series of multiple operations is performed (add, subtract, divide, multiply), all available significant figures are carried through the calculations and the result is rounded to the appropriate number of significant figures.

III. ARLLC compares concentration values to reporting limits prior to rounding final concentration values. Example: with an RL of 0.50, 0.499 is undetected at 0.50 (0.50U) and 0.504 is detected at 0.50.

III. ARLLC will round quality control results prior to determining if the value is in control. Example: for spike recovery limits of ± 10% (90 – 110%), a recovery of 110.47 is in control at 110% and a calculated recovery of 110.50 is out of control at 111%.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**13**
SUBJECT:	**Use of "J" Flag when Reporting Analytical Data**
DATE of IMPLEMENTATION:	**3/1/09**

1. ARLLC uses a "J" flag to indicate that a quantitative result chemical analysis is an estimated value. In general, "J" flags note positively identified target analytes that are below an instrument's verified calibrated range.
2. A "J" indicates quantitative values with a high degree of uncertainty. Data users must consider the greater uncertainty when using "J" flagged quantitative values.
3. ARLLC will not report analytes below the RL ("J" flag is not used) for any single column GC fuel analysis unless there is a positive pattern identified for the fuel (HCID, TPH-D, BTEX, TPH-G.
4. ARLLC will not report analytes below the RL for any single column GC analysis that quantifies specific analytes or has no pattern (RSK-175, Direct Aqueous Injection)
5. ARLLC uses "J" flags when reporting results of GC-MS (VOA and SVOA) and dual column GC analyses using the following criteria:
   A. All analyses must meet ARLLC established QA criteria for calibration and spike recovery.
   B. Analytes must meet method specific identification criteria (i.e., spectral match, retention time and/or relative retention time).
   C. The analyte concentration must exceed the greater of either the MDL or ½ the reporting limit before a "J" flag is applied.
   D. An analyte in a method blank will be "J" flagged only when any associated sample contains the same analyte.
   E. The application of a "J" flag is discretionary, depending on the professional judgment of ARLLC's data reviewers. GC-MS parameters such as ion ratios, spectral match, background contamination and instrument noise are weighted when considering the application of "J" flags.
6. Some typical circumstances that may warrant the use of a "J" flag:
   A. A compound identified at a concentration between the MDL or ½ RL and ARLLC's reporting limit (normally the low concentration used to calibrate the instrument).
   B. The quantified values in a dual column GC analysis differ by > 40% with obvious interference on one column. ARLLC may report the value with the lowest concentration or the least interference.
   C. The analyte is present at low concentration due to extract dilution and identified in a previous analysis of less dilute extract.
   D. Analytes < the RL and reported in previous analyses from the same sampling site.
   E. An analyte is < the RL in a sample and greater than the RL a duplicate or replicate analysis. This often applies to Matrix Spike and Blank Spike samples and their duplicates.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**14**
SUBJECT:	**Calculation of Holding Times**
DATE of IMPLEMENTATION:	**7/1/13**

1. Holding Time (HT) (Maximum Allowable Holding Time) definition: The maximum elapsed time that samples may be held prior to analysis and still be considered valid or not compromised. (40 CFR Part 136). (DoD Clarification): The time elapsed from the time of sampling to the time of extraction or analysis, or from extraction to analysis, as appropriate. A specific time as defined in this policy will include the year, month, day of the month, hour and minute for each event.

2. Holding times are prescribed in published analytical methods and are normally specified in either days or hours. ARLLC will determine holding times based on the published time units specified. The time of sample collection is considered time (hour, day etc.) zero.

3. Holding time will commences as follows:
    a. **Environmental Samples**: The moment the sample is separated from its natural environment. ARLLC will assume this is the sampling time recorded on the Chain of Custody form delivered to the lab with the sample.
    b. **Extracts for Organic Analysis**: The moment the extract is delivered to the instrument laboratory as documented in ARLLC's chain of custody records.

4. Elapsed holding time will end as follows:
    a. **Samples for VOA Analysis**: At the time trap desorption/GC analysis begins as recorded by the chromatography data system.
    b. **Samples for Solvent Extraction**: The moment the extraction solvent touches the sample. This is a batch process with the beginning and ending time recorded on the extraction bench sheet.
    c. **Samples for Acid Digestion**: The moment acid touches the sample. This is a batch process with the beginning and ending time recorded on the preparation bench sheet.
    d. **Samples for Solids Analysis**: The moment the sample is placed in the oven or filtration begins as recorded on the analysis bench sheet.
    e. **Samples to be Distilled**: At the moment the sample is placed in the distillation flask. This is a batch process with the beginning and ending time recorded on the analysis bench sheet.
    f. **Sediment for Pore Water Extraction**: When the sediment is placed in a centrifuge tube.
    g. **Extracts for Organic Analysis**: The moment the sample, extract or digestate is introduced into the instrument as recorded by the instrument data system.

5. Reporting of Holding Times: The time of sample collection, preparation, and analysis are included in the final laboratory report, regardless of the length of holding time. If the time of the sample collection is not provided, ARLLC will assume the most conservative time of day. When the date of sampling is not available, the assumed holding time will start when the samples are formally accepted by ARLLC. For batch processing, the start and stop dates and times of the batch preparation will be reported.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**15**
SUBJECT:	**Subcontracting Samples**
DATE of IMPLEMENTATION:	**7/1/13**

ARLLC may subcontract analysis to other laboratories. The following policies are followed to help ensure that data produced by a subcontractor will meet ARLLC's expectation for quality, defensibility, repeatability and will meet ARLLC's client's expectations.

1. ARLLC's client must be made aware that samples will be subcontracted and what laboratory will perform the analyses.
2. Subcontractor laboratories must qualify to perform the analyses using the same criteria applied to ARLLC. When appropriate, subcontracted laboratories must submit proof of certification or accreditation, quality assurance plans, standard operating procedures, results of method detection limit studies and control limits to ARLLC.
3. ARLLC may request that subcontract laboratories analyze, a double-blind performance testing (PT) sample for the subcontracted analysis obtained from commercial vendors at the subcontractor's expense.
4. ARLLC may at its discretion perform an on-site assessment of a subcontract laboratory. Failure to submit requested documents or refusal of an on-site assessment will disqualify laboratories from subcontracting ARLLC sample analyses.
5. Department of Defense (DoD) work to be performed under the Quality Systems Manual (DoD-QSM) must be subcontracted to a DoD Environmental Laboratory Accreditation Program (DoD-ELAP) accredited laboratory.
6. The sample information and analytical requirements for subcontracted analyses are first entered into ARLLC LIMS in the same way that samples for in-house analyses are processed. Subcontractor laboratories are contacted to verify their preparedness, and samples are then submitted to them using ARLLC chain-of-custody forms.
7. The laboratory must be willing to maintain an annual contract with ARLLC and must list ARLLC as a co-insured on the subcontract laboratory's professional and general liability insurance policies.
8. Financial stability is also evaluated on a lab-by-lab basis.

Appendix J

References

ISO/IEC 17025. General Requirements for the Competence of Testing and Calibration Laboratories.

UNIDO. 2009. Complying with ISO/IEC 17025. United Nations Industrial Development Organization.

ISO 9001. Standards for Quality Management Systems.

EPA 2001. EPA Requirements for Quality Management Plans. EPA QA/R-2. EPA/240/B-01/002

ANSI/ASQC E4-1994. Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs. American National Standard.

QUALITY ASSURANCE MANUAL

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ALS HOUSTON QUALITY ASSURANCE MANUAL

DOCUMENT ID: ALSHS-QAM, REV 12.0

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1) Introduction and Scope

The purpose of this Quality Assurance Manual is to outline the quality system for the Houston division of ALS Group USA, Corp (ALS USA, Corp). The Quality Assurance Manual defines the policies, procedures, and documentations that assure analytical services continually meet a defined standard of quality that is designed to provide clients with data of known and documented quality and, where applicable, demonstrate regulatory compliance. ALS SOPs are referenced in this document to direct the reader to more complete information.

We recognize that quality assurance requires a commitment to quality by everyone in the organization - individually, within each operating unit, and throughout the entire laboratory. Laboratory management is committed to ensuring the effectiveness of its quality systems and to ensure that all tests are carried out in accordance with customer requirements. Key elements of this commitment are set forth in SOP CE-GEN001, *Laboratory Ethics and Data Integrity* and in this Quality Assurance Manual (QAM). ALS – Houston is committed to operate in accordance with these requirements and those of regulatory agencies, accrediting authorities, and certifying organizations. The laboratory also strives for improvement through varying continuous improvement initiatives and projects.

Quality Control (QC) procedures are used to continually assess performance of the laboratory and quality systems. The laboratory maintains control of analytical results by adhering to written standard operating procedures (SOPs), using analytical control parameters with all analyses, and by observing sample custody requirements. All analytical results are calculated and reported in units consistent with project specifications to allow comparability of data.

The Quality Manual sets the standard under which all laboratory operations are performed, including the laboratory's organization, objectives, and operating philosophy. This Standard is consistent with ISO/IEC 17025:2017 and all requirements that are relevant to the scope of environmental testing services and various accreditation and certification programs listed in Appendix F.

1.1 Scope of Testing

ALS Group USA, Corp provides analytical services for many matrices, including aqueous, soil, sediment, solid waste, biological tissue, and air using analytical protocols defined by EPA Approved Methods. ALS Group USA, Corp strives to provide analytical test results that are of the type and quality needed and expected by our customers.

ALS maintains certifications pertaining to various commercial and government entities. Each certification requires that the laboratory continue to perform at levels specified by the programs issuing certification. Program requirements can be rigorous; they include performance evaluations as well as annual audits of the laboratory to verify compliance.

1.2 Glossary and Acronyms Used

1.2.1 Glossary

The Terms and Definitions Section of the TNI Standard are adopted by ALS. Specifically, Modules 1-7 in the 2016 TNI Environmental Laboratory Sector Standard – Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis (EL-V1, M1 through M7, ISO/IEC 17025:2017) are adopted.

1.2.2 Acronyms – See Appendix A

1.3 Management of the Quality Assurance Manual

1.3.1 The Quality Assurance Manager is responsible for maintaining the currency of the Quality Assurance Manual.

1.3.2 The Quality Manual is reviewed annually by the Quality Assurance Manager and laboratory personnel to ensure it still reflects current practices and meets the requirements of any applicable regulations or client specification.

1.3.3 The Quality Assurance Manual is considered confidential within the Houston division of ALS Group USA, Corp and may not be altered in any way except by approval of the Laboratory Director, Technical Director and Quality Assurance Manager. If it is distributed to external users, it is for the purpose of reviewing the management system and may not be used for any other purpose without written permission.

2) Organization

2.1 The laboratory is responsible for carrying out testing activities that meet the requirements of the TNI Standard, the DOD/DOE Quality Systems Manual (QSM) for Environmental Laboratories, and that meet the needs of the client, the regulatory authorities or organizations providing recognition. Through application of the policies and procedures outlined in this Section and throughout the Quality Assurance Manual:

2.1.1 Management and technical personnel have the authority and resources to carry out their duties and have procedures to identify and correct departures from the laboratory's management system.

2.1.2 Personnel understand the relevance and importance of their duties as related to the maintenance of the laboratory's management system.

2.1.3 Ethics and data integrity procedures (see SOP CE-GEN001 Ethics) ensure personnel do not engage in activities that diminish confidence in the laboratory's capabilities.

2.1.4 The purpose of the QA program at ALS Environmental, Houston is to ensure that our clients are provided with analytical data that is scientifically sound, legally defensible, and of known and documented quality.

2.2 Laboratory Organizational Structure

ALS Group USA, Corp is a wholly owned subsidiary of ALS Limited. The laboratory is a commercial operation located at 10450 Stancliff Road, Suite 210, Houston, Texas, 77099. The Laboratory director, Sarah Packett can always be reached at (281) 530-5656.

An organization chart is provided in Appendix B that shows the operational structure and reporting relationships in the laboratory.

Additional information regarding responsibilities, authority and interrelationship of personnel who manage, perform or verify testing is included in Section 3 – "Management" and Section 20 – "Personnel". These Sections also include information on supervision, training, technical management, job descriptions, quality personnel, and appointment of deputies for key managerial personnel.

2.3 Impartiality, Conflict of Interest and Undue Pressure

The organizational structure indicated above minimizes the potential for conflicting or undue interests that might influence the technical judgment of analytical personnel. In addition, procedures are in place to prevent outside pressures or involvement in activities that may affect competence, impartiality, judgment, operational integrity, or the quality of the work performed at the laboratory.

2.4 The laboratory management team is responsible for and committed to safeguarding impartiality of laboratory activities, and therefore shall not allow commercial, financial or other pressures to compromise impartiality.

All employees are required to enter into the following agreements:

- **Code of Conduct Agreement**
  Provides a framework for decisions and actions in relation to conduct in employment. The agreement covers a wide range of topics including personal and professional behavior, conflicts of interest, gifts, confidentiality, legal compliance, security of information, among others. The code of conduct agreement is administered by the USA Human Resources department. This agreement is provided to the employee during the hiring and induction process and the agreement is reviewed and signed.

- **Confidentiality Agreement**
  Describes policies for identifying and protecting information owned by ALS and its customers, and for keeping this information in confidence. The confidentiality agreement is administered by the USA Human Resources department. This agreement is provided to the employee during the hiring and induction process and the agreement is reviewed and signed.

- **Ethics and Data Integrity Agreement**
  Provided to the employee as part of the hiring and induction process and reviewed during periodic ethics refresher training. This is coordinated between the Human Resources and Quality Assurance (QA) departments. This training is provided to the employee during the hiring and induction process and the Certificate of Completion is printed and signd. All employees are required to take annual ethics and data integrity refresher training

3) Management

3.1 Management Responsibility

3.1.1 The Laboratory Management includes the titles of Laboratory Director, Technical Director, Quality Assurance Manager, Information Technology Manager, Project Managers, Safety Officer and Department Supervisors/Managers. Roles and duties are defined in Section 3.2 below.

3.1.2 Management has overall responsibility for the technical operations and the authority needed to generate the required quality of laboratory operations.

3.1.3 Management ensures communication within the organization to maintain an

effective management system and to communicate the importance of meeting customer, statutory, and regulatory requirements.

3.1.4 Management assures that the system documentation is known and available so that appropriate personnel can implement their part.

3.1.5 When changes to the management system occur or are planned, managers ensure that the integrity of the system is maintained.

3.1.6 Managers implement, maintain, and improve the management system, and identify noncompliance with the management system or procedures.

3.1.7 Managers initiate actions to prevent or minimize noncompliance.

3.1.8 Management must ensure technical competence of personnel operating equipment, performing tests, evaluating results, or signing reports, and limits authority to perform laboratory functions to those appropriately trained and/or supervised, HS-QS013 Employee Training.

3.1.9 Management is responsible for defining the minimal level of education, qualifications, experience, and skills necessary for all positions in the laboratory and assuring that technical staff have demonstrated capabilities in their tasks.

3.1.10 Management must ensure training is kept up to date by periodic review of training records and through employee performance review.

3.1.11 Management bears specific responsibility for maintenance of the management system. This includes:

3.1.11.1 Defining roles and responsibilities of personnel

3.1.11.2 Approving documents

3.1.11.3 Providing required training

3.1.11.4 Providing a procedure for confidential reporting of data integrity issues, and periodically reviewing data, laboratory procedures, and documentation.

3.1.11.5 The assignment of responsibilities, authorities, and interrelationships of the personnel who manage, supervise, perform, or verify work affecting the quality of environmental tests is documented in Section 20.

3.1.11.6 Management ensures that audit findings and corrective actions are completed within required time frames.

3.1.11.7 ALS management also views risk management as a key component of its governance responsibilities and an essential process in achieving and mandating a viable organization. ALS is committed to enterprise wide risk management to ensure its corporate governance responsibilities are met and its strategic goals are realized. See SOP HS-QS023 Risks and Opportunities.

3.2 Roles and Duties

3.2.1 Laboratory Director: Responsible for all laboratory activities as the highest level manager. The Laboratory Director provides administrative, financial, operational, and technical leadership through planning, allocation and

management of personnel and resources. Provides resources for implementation of the QA program and reviews and approves the Quality Assurance Manual. Requires a BS or BA degree in Science, Engineering or Management, and five years of supervisory experience in environmental laboratory operations. This individual is an approved signatory for all facility policies and procedures.

3.2.2 Technical Director: Assures reliable data through the following activities: method development, monitoring quality control performance, monitoring the validity of generated data and corroborating the analysis performed. The Technical Director certifies that personnel with appropriate educational and/or technical background perform all tests for which the laboratory is accredited; reviews new methods for their applicability to a project, implements new methodology at the facility, and directs, trains and supervises individuals participating in this effort. in the case of the Technical Director's absence, Departmental Lab Managers shall maintain these duties. Requires a BS or BA degree in Science, Engineering or Management (with at least 24 college semester credits in chemistry), and five years technical supervisory experience in environmental laboratory operations. This individual is an approved signatory for all facility policies and procedures, as well as training documentation. Changes to this position must be communicated to accreditation bodies within 30 days of the change. In the event of the Technical Director being absent for more than 45 days such as on leave, accreditation bodies must be notified of the Technical Director absence.

3.2.3 Operations Manager: Manages all laboratory departments, scheduling, productivity, reporting and evaluation of analytical methodologies, project planning, budgeting, and Quality Assurance/Quality Control protocol oversight. Supports the development and execution of strategic and business plans for the business. Responsible for ensuring that the client service provided is consistent, of high quality, and meets ALS Group guidelines. Other responsibilities include conducting facility compliance reviews; providing departmental support for equipment purchases; ensures laboratory equipment is of the standard required to meet or exceed Data Quality Objectives (DQOs), resolving personnel issues; determining resource allocation; and providing supervision, training, and leadership to key laboratory staff. Assesses the results of QA/QC audits and implement improvements as required. Ensures the required turnaround time (compliance and average days) for samples is achieved and maintained whilst ensuring the highest quality of results for clients. Works closely with the Corporate Human Resource and Corporate Compliance Department to achieve the management of human resources within the laboratory including Employee Training Programs (technical, supervisory, and safety), Employee Mentoring Programs, Employee career development, Recruitment, Induction, and Performance Management.

3.2.4 Quality Assurance Manager: Has the authority and responsibility for implementing, maintaining and improving the quality system; ensures that all personnel understand the quality system. This includes coordination of QA activities within the laboratory, ensuring that personnel understand the quality system, ensuring communication takes place at all levels within the laboratory regarding the effectiveness of the quality system, evaluating the effectiveness of training; and monitor trends and continually improve the quality system. Audit

and surveillance results, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews can all be used to support quality system implementation. The QA Manager is responsible for ensuring compliance with TNI standards (and ISO, DoD QSM, etc. as applicable). The QA Manager works with laboratory staff to establish effective quality control and assessment plans and has the authority to stop work in response to quality problems. The QA Manager is responsible for maintaining the QA Manual and performing an annual review of it; reviewing and approving SOPs and ensuring the annual review of technical SOPs; maintaining QA records such as metrological records, archived logbooks, PT results, etc.; document control; conducting proficiency testing studies; approving nonconformity and corrective action reports; maintaining the laboratory's certifications and approvals; and performing internal QA audits. The QA Manager maintains a general knowledge of the analytical test methods performed in the facility. In the case of absence, the QA Generalist or the Technical Director shall maintain these duties. Requires a BS or BA degree in Science preferably in Chemistry or any other physical science and five years of experience in environmental laboratory and two years of experience in quality system management. This individual is an approved signatory for all policy and procedural documents within the facility. Changes to this position must be communicated to accreditation bodies within 30 days of the change.

The QA Manager reports directly to the Laboratory Director and reports indirectly to the ALS Quality Improvement Manager, USA. It is important to note that when evaluating data, the QA Manager does so in an objective manner and free of outside, or managerial, influence.

The ALS Quality Improvement Manager, USA is responsible for the overall QA program at all the ALS Environmental laboratories. The ALS Quality Improvement Manager, USA is responsible for oversight of QA Managers' regulatory compliance efforts (TNI, ISO, DoD, etc). In addition, may perform internal audits to evaluate compliance. This person also approves company-wide SOPs and provides assistance to the laboratory QA staff and laboratory managers as necessary.

3.2.4 Information Technology Manager: Reports directly to the Laboratory Director; responsible for maintaining the Laboratory Information Management System (LIMS) and other specific computer software and hardware pertinent to laboratory activity. Functions include maintaining the computer network, IT systems development and implementation, education of analytical staff in the use of scientific software, software implementation and control, Electronic Data Deliverables (EDDs), data back-up, data archiving, and maintaining electronic data integrity and maintaining procedures and methodologies for:maintaining historical file of software, software version and change control, defining acceptance criteria, testing, records, and approval for changes in LIMS hardware and communication equipment. The IT Manager requires an Associate of Science degree in Information Systems or Computer Science, and five years of experience in computers and network information system hardware and software. This individual is an approved signatory for policy and procedures related to Information Technology.

3.2.5 Project Managers (PM): Senior level scientists that interface with both laboratory

supervision and the client. Project Managers report to the Laboratory Director. Project Managers are responsible for ensuring that the analyses performed by the laboratory meet all project, contract, and regulatory-specific requirements. The PM relays the project details, requested by the customer, to the laboratory staff. The PM reviews all sample log-in information; helps direct turnaround time commitments and reviews all final reports. BS or BA degree in Science, Engineering or Management is preferred but not required and five years of experience in environmental laboratory operations. This individual is an approved signatory for client reports.

3.2.6 Client Services Manager (CSM) – The CSM is responsible for all aspects of client services within the laboratory. This includes management and oversight of Project Managers, electronic deliverables, and support functions. The laboratory provides a complete interface with clients from initial project specification to final deliverables. The Client Services Manager has the responsibility and authority to stop work in response to accreditation/certification or quality problems, or in response to similar subcontractor quality problems.

3.2.7 Health and Safety Environmental (HSE) Officer : Responsible for the administration of the laboratory's safety program: Designated as the Chemical Hygiene Officer and reports directly to the Laboratory Director. The HSE Officer is coordinator for the Safety Committee, implements safety policies, supervises new employee safety training, reviews any accidents or incidents, prepares prevention plan; monitors hazardous waste disposal, and conducts routine safety inspections. Requires a high school diploma, completion of a 40-hr OSHA Safety training course (or designate personnel) and two years of experience in the environmental laboratory. This individual is an approved signatory for all policies and procedures related to Safety. The HSE Officer has a dotted-line reporting responsibility to ALS North America HSE Manager.

3.2.8 Sample Management Supervisor: The Sample Management Office plays a key role in the laboratory QA program by handling all activities associated with receiving, storage, and disposal of samples, bottle preparation, and maintaining documentation for all samples received. SMO staff is also responsible for the proper disposal of samples after analysis. The SMO Supervisor reports to the Client Services Manager; Requires a high school diploma, and two years of experience in the environmental laboratory. This individual is an approved signatory for all policies and procedures related to Sample Management.

3.2.9 Department Supervisors/Managers: Responsible for a technical supervision of technical operation in their area of laboratory responsibility (e.g. Organics Manager). They report to the Technical Director; are full-time members of the staff and assure reliable data through the following activities: monitoring quality control, corroborating the analysis performed, and provide supervision to staff in training, assuring demonstrations of capability are performed by the departmental staff upon completion of training and then annually; they assist the Technical Director in certifying that personnel with appropriate educational and/or technical background perform all tests for which the laboratory is accredited. A department manager has the authority to stop work in response to quality problems in their area. Requires a BS or BA degree in Science, Engineering or Management, and five years technical supervisory experience in environmental laboratory operations. Department Managers are

approved signatories for policies and procedures for their respective areas. They are also approved signatories on raw data. Changes must be communicated to accreditation bodies within 30 days of change to this position.

3.3 Laboratory Key Personnel Deputies

The following table defines who assumes the responsibilities of key personnel in their absence if the absence is more than 15 days:

Key Personnel	Deputy
Laboratory Director	Operations Manager
QA Manager	QA Generalist
Technical Director	Organic Manager Inorganics Manager HRMS Manager
Operations Manager	HRMS Manager

3.4 Quality Policy

ALS is committed to producing legally defensible analytical data of known and documented quality acceptable for its intended use and in compliance with applicable regulatory programs. This QAM is designed to satisfy the applicable requirements of the various States, United States Environmental Protection Agency (USEPA), Current TNI Volume 1, current Department of Defense Quality Systems Manual, and current ISO 17025.

ALS corporate management has committed its full support to provide the personnel, facilities, equipment, and procedures required by this QAM and other client and project related requirements.

ALS management reviews its operations on an ongoing basis and seeks input from staff and clients to make improvements

Management's commitment to quality and to the management system is stated in the Quality Policy below, which is upheld through the application of related policies and procedures described in this Quality Assurance Manual and associated quality system documents

Quality Policy Statement

The objective of the quality system, and the commitment of management, is to consistently provide our customers with data of known and documented quality that meets their requirements. Our policy is to use good professional practices, to maintain quality, to uphold the highest quality of service, and to comply with TNI and the DOD ELAP Standard. However, the primary responsibility for quality rests with each individual within the laboratory organization. ALS managers are committed to continually improve the effectiveness of the management system. Every laboratory employee must ensure that the generation and reporting of quality analytical data is a

fundamental priority. All laboratory employees are required to familiarize themselves with the quality documentation and to implement the policies and procedures in their work.

3.5 Impartiality, Ethics, Professional Conduct and Data Integrity

One of the most important aspects of the success of ALS – Houston is the emphasis placed on the structure in place to manage and safeguard against impartiality, the integrity of the data provided, and the services rendered. This success is reliant on the professional conduct of all employees within ALS – Houston well as established laboratory practices. All personnel involved with environmental testing and calibration activities must familiarize themselves with the quality documentation and implement the policies and procedures in their work.

All management and employees are committed to acting impartially and are required to sign and adhere to the requirements set forth in the *ALS Code of Conduct Policy* and agree to the *Confidentiality Agreement*.

3.5.1 Professional Conduct

- To promote quality, ALS – Houston requires certain standards of conduct and ethical performance among employees. The following examples of documented ALS policy are representative of these standards, and are not intended to be limiting or all-inclusive:
- Under no circumstances is the willful act of fraudulent manipulation of analytical data condoned. Such acts are to be reported immediately to senior management for appropriate corrective action.
- Unless specifically required in writing by a client, alteration, deviation or omission of written contractual requirements is not permitted. Such changes must be in writing and approved by senior management.
- Falsification of data in any form will not be tolerated. While much analytical data is subject to professional judgment and interpretation, outright falsification, whenever observed or discovered, will be documented, and appropriate remedies and punitive measures will be taken toward those individuals responsible.

3.5.2 Confidentiality

It is the responsibility of all laboratory employees to safeguard sensitive company information, client data, records, and information; and matters of national security concern should they arise. The nature of our business and the well-being of our company and of our clients is dependent upon protecting and maintaining confidential and/or proprietary company and client information. All information, data, and reports (except that in the public domain) collected or assembled on behalf of a client is treated as confidential.

Information may not be given to third parties without the consent of the client. Unauthorized release of confidential information about the company or its clients is taken seriously and is subject to formal disciplinary action. All employees sign a confidentiality agreement upon hire to protect the company and client's confidentiality and proprietary rights. When the laboratory is required by law or authorized by contractual agreement to release confidential information, the customer or individual concerned shall, unless prohibited by law, be notified of the information provided. Information about the customer

obtained from sources other than the customer (e.g. complainant, regulators) shall be confidential between the customer and the laboratory. The provider of this information shall be confidential to the laboratory and shall not be shared with the customer, unless agreed by the source. Personnel, including any committee members, contractors, personnel of external bodies, or individuals acting on the laboratory's behalf, shall keep confidential all information obtained or created during the performance of laboratory activities, except as required by law.

3.5.3 Prevention and Detection of Improper, Unethical, or Illegal Actions

It is the intention of the laboratory to proactively prevent and/or detect any improper, unethical, or illegal action conducted within the laboratory. This is performed by the implementation of a program designed for not only the detection but also prevention. Prevention consists of educating all laboratory personnel in their roles and duties as employees, company policies, inappropriate practices, and their corresponding implications as described here.

In addition to education, appropriate and inappropriate practices are included in SOPs such as manual integration, data review, and specific method procedures. Electronic and hardcopy data audits are performed regularly, including periodic audits of chromatographic electronic data. Requirements for internal QA audits are described in SOP HS-QS012, Internal Audits. All aspects of this program are documented and retained on file according to the company policy on record retention.

The ALS Employee Handbook also contains information on the ALS ethics and data integrity program, including mechanisms for reporting and seeking advice on ethical decisions.

3.5.4 Laboratory Data Integrity and Ethics Training

Each employee receives in-depth “core” Data Integrity/Ethics Training. New employees are given a QA and Ethics orientation within the first month of hire, followed by the core training within 1 year of hire. On an ongoing basis, all employees receive annual ethics refresher training. Topics covered are documented in writing and all training is documented. It is the responsibility of the QA Manager to ensure that the training is conducted as described.

Key topics covered are the organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting, how and when to report data integrity issues and record keeping. Training includes discussion regarding all data integrity procedures, data integrity training documentation, in-depth data monitoring and data integrity procedure documentation.

Trainees are required to understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, or civil/criminal prosecution.

The training session includes many concepts and topics, numerous examples of improper actions (defined by DoD as deviations from contract-specified or method-specified analytical practices and may be intentional or unintentional), legal and liability implications (company and personal), causes, prevention, awareness, and reporting mechanisms.

ALS is committed to ensuring the integrity of its data and providing valid data of known and documented quality to its clients. The elements of the Ethics and Data Integrity program include:

- Documented data integrity procedures signed and dated by top management.
- An Ethics and Data Integrity Policy signed by all management annually (SOP CE-GEN001 Ethics). This policy is signed, dated and distributed by the Quality Assurance Manager.
- Manual Integrations (SOP HS-QS016)
- Nonconformance and Corrective Action Procedures (SOP HS-QS003)
- Data recall procedures (SOP CE-GEN006)
- Annual data integrity training.
- Procedures for confidential reporting of alleged data integrity issues.
- An audit program that monitors data integrity and procedures for handling data integrity investigations and client notifications.

In addition to the agreements, project managers act as a firewall to insulate the analysts from clients so that the lab personnel have no contact with clients. Lab IDs are assigned to samples and used throughout preparation and analysis to make the samples ambiguous to lab personnel. Together these agreements and procedures ensure freedom from undue internal and external commercial, financial, and other pressures or influences that could adversely affect the quality of work. They protect customers' confidential information and ALS' proprietary rights. They ensure avoidance of activities that could diminish confidence in the competence, impartiality, judgment or integrity of any ALS laboratory and staff.

3.5.5 Investigations

All investigations resulting from data integrity issues are conducted confidentially. They are documented and notifications are made to clients who received any negatively affected data that did not meet the client's data quality requirements. Procedures for investigation are included in CE-GEN001.

3.5.5.1 All reports of suspected improper action or errors in reporting must be investigated to determine the validity of the reported data. All results that require correction must be revised and changes must be communicated to the client in writing.

3.5.5.2 The Laboratory Director, with assistance of the Quality Assurance Manager, must develop a plan to confidentially investigate the issue, resolve the problem, and contact any affected clients. The investigation may include personnel interviews, data audits, training evaluations, data package review, internal method audits and surveillance to determine inappropriate practices.

3.5.5.3 The QA Manager must investigate if the inappropriate practice has an impact on data integrity and reported values. The QA Manager must complete a comprehensive report to management with investigations findings and recommendations for training, corrective actions, and communication of incident to ALS staff. The QA Manager will facilitate client contact procedures and notify all acreditation body of any instance of inappropriate and prohibited practice (and data recall if required) from the findings witin 15 days of discovery. Corrective action or proposed corrective actions must be submitted to accrediting bodies within 30 days of discovery.

3.5.5.4 ALS management will take necessary steps to prevent the problem from recurring, including the retraining of staff on ethics and other related procedures. If an investigation indicates improper, unethical or illegal practices by any ALS employee, disciplinary action will be taken. Disciplinary action may include termination and legal action.

3.5.6 Public Disclosure

In the event that and internal investigation reveals that improper, unethical or illegal practices have occurred, all affected clients and accrediting body must be notified as soon as possible, and full disclosure shall be made to all affected regulatory agencies. This disclosure must occur within 10 working days (or shorter period if required by law) after ALS has discovered that a violation has occurred or may have occurred and must be in writing to any relevant state regulatory agency or accrediting body. Corrective action(s) implemented must be submitted to all affect clients and accrediting bodies.

Note DOD requires notification of all affected customers and accrediting body of potential data quality issues resulting from nonconforming work within 15 business days. Notification shall be performed according to a written procedure. Records of corrections taken or proposed corrective actions to resolve the nonconformance shall be submitted to the customer(s) and accrediting body within 30 business days of discovery.

3.6 Management and Employee Commitment

The laboratory makes every attempt to ensure that employees are free from any commercial, financial, or other undue pressures that might affect their quality of work. Related policies are described in the laboratory Employee Handbook. This includes:

- ALS Open Door Policy (ALS Employee Handbook) – Employees are encouraged to bring any work related problems or concerns to the attention of local management or their Human Resources representative. However, depending on the extent or sensitivity of the concern, employees are encouraged to directly contact any member of upper management.
- FairCall – An anonymous and confidential reporting system available to all employees that is used to communicate misconduct and other concerns. The program shall help minimize negative morale, promote a positive work place, and encourage reporting suspected misconduct without retribution. Associated upper management is notified and the investigations are documented.

- Use of flexible work hours. Within reason and as approved by supervisors, employees are allowed flexible work hours in order to help ease schedule pressures which could impact decision-making and work quality.
- Operational and project scheduling assessments are continually made to ensure that project planning is performed and that adequate resources are available during anticipated periods of increased workloads. Procedures for subcontracting work are established, and within the laboratory network additional capacity is typically available for subcontracting, if necessary.
- Gifts and Favors (ALS Employee Handbook) – To avoid possible conflict of interest implications, employees do not receive unusual gifts or favors to, nor accept such gifts or favors from, persons outside the Company who are, or may be, in any way concerned with the projects on which the Company is professionally engaged.

3.7 Order of Precedence - In the event of a conflict or discrepancy between policies, the order of precedence is as follows unless otherwise noted:

3.7.1 Quality Assurance Manual

3.7.2 SOPs and Policies - Laboratory SOPs will have precedence over Corporate SOPs.

3.7.3 Other (Work Instructions, memos, flowcharts, etc.)

4) Document Control

4.1 This Section describes how the laboratory establishes and maintains a process for document management. Procedures for document management include controlling, distributing, reviewing, and accepting modifications. The purpose of document management is to preclude the use of invalid and/or obsolete documents.

4.2 Documents can be SOPs, policy statements, specifications, calibration tables, charts, textbooks, posters, notices, memoranda, software, drawings, plans, etc. These may be on various media, whether hard copy or electronic, and they may be digital, analog, photographic or written.

Note: There is a difference between records and documents. Documents include statements, identify requirements, or provide an explanation related to operations in the laboratory. Records are data (observational, qualitative or quantitative) that are generated manually or electronically during laboratory activities. Logbooks present an interesting case. The logbook form is a document that is tracked with a unique document control number as in §4.4.1. However, once printed and bound for entering data into, they also receive a unique Records Tracking number as specified in §17.

4.3 Types of Documents: The laboratory manages two types of documents: 1) controlled, 2) obsolete.

4.3.1 Controlled Documents - A Controlled Document is one that is uniquely identified, issued, tracked, and kept current as part of the management system. Controlled documents may be internal documents (i.e. SOPs) or external documents (i.e. published methodologies, instrument manuals, etc).

4.3.2 Obsolete documents are those that have been superseded by more recent versions or are no longer needed. Original obsolete internal documents (i.e.

SOPs) are maintained in archive storage within the QA drive.

4.4 Document Approval: All documents that affect the quality of laboratory data are managed appropriate to the scope and depth required. Controlled internal/ Laboratory documents will be reviewed and approved for use by the QA Manager and/or the Technical Director and the department supervisor, where applicable. Internal documents are reviewed annually to ensure their contents are suitable and in compliance with the current quality systems requirements, and accurately describe current operations. Approved copies of documents (internal and external) are available at all locations where operations are essential to the effective functions of the laboratory.

4.4.1 Controlled internal documents are uniquely identified with 1) a unique name or number identification 2) Effective date, 3) revision identification, 4) page number, 5) the total number of pages (or a mark to indicate the end of the document), and 6) the identification or signatures of the issuing authority (i.e. management).

4.5 Document Master List: A master list of controlled internal documents is maintained that includes distribution, location, and revision dates. A master list of controlled external documents is also maintained that includes title, author, version, and department. The controlled document list is maintained by the QA Department. The controlled document list is updated each time a new document is added to the quality system.

4.6 Standard Operating Procedures: SOPs are approved controlled documents and are used to ensure consistency of application of common procedures.) Where equipment manuals or published methods accurately reflect laboratory procedures in detail, a separate SOP may not be required.

4.6.1 SOP Location: The laboratory SOPs for all test methods can be accessed on the secure local laboratory network.

4.6.2 Any deviation from a test method SOP must be documented and approved by QA, including both a description of the change made and a technical justification. The deviation from a test method in a SOP must be reported to the client or be agreed upon as part of client project specification or requirement.

4.6.3 All SOPs are written, maintained and archived according to the guidelines of the SOP HS-GEN001 Preparation and Management of SOPs.

4.7 Electronic Signature Policy

4.7.1 It is a policy of ALS Environmental to allow the use of electronic signatures. For data reporting an electronic signature may be applied to the report by an approved report signatory and is binding to the same extent as a handwritten wet signature.

4.7.2 To authenticate the electronic signature, the identity of the signatory is verified before their electronic signature can be created. Each electronic signature shall be unique to a single individual and shall not be used by any other individual. Following login, these credentials are used to identify and document the user.

5) Review of Requests, Tenders and Contracts

5.1 The review of all new work assures that oversight is provided so that requirements are clearly defined, the laboratory has adequate resources and capability, and the test method is applicable to the customer's needs. This process assures that all work will be given adequate attention without shortcuts that may compromise data quality. Contracts for new work may be formal bids, signed documents, or other communication, either verbal or electronic.

5.2 The Laboratory Project Management Group and the Laboratory Director determine if the laboratory has the necessary accreditation, resources, including schedule, equipment, deliverables, and personnel to meet a work request. Every client is assigned to a designated Project Manager, who informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to the complete the work satisfactorily.

5.3 Projects submitted under the Department of Defense Quality System Manual for Environmental Laboratories (DoD-QSM), current version, must follow project-specific requirements for data quality objectives. These requirements are typically outlined in a project-specific quality assurance project plan (QAPP). See also SOP HS-GEN009. Where project-specific requirements are not provided, the quality control requirements and acceptance limits outlined in Appendix B of the Current DoD-QSM must be met.

5.4 The client must be informed of any deviation from a contract including the test method or sample handling processes. All differences between the request and a final contract are resolved and recorded before any work begins. It is necessary that the contract be acceptable to both the laboratory and the client. This review process is repeated when there are amendments to the original contract by the client. The participating laboratory personnel are given copies of the amendments.

5.5 Records are maintained for every contract or work request, when appropriate by the Project Manager. This includes pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract.

6) Subcontracting of Tests

6.1 A subcontract contract laboratory is defined as a laboratory external to ALS Environmental –Houston facility, or at a different location than the address indicated on the front cover of this manual, that performs analyses on behalf of ALS Environmental Houston. When subcontracting analytical services, the project management group must assure work requiring accreditation is placed with an appropriately accredited laboratory or one that meets applicable statutory and regulatory requirements for performing the tests. To assure this, a list of accredited subcontractors is maintained on the laboratory network for those fields of testing clients routinely requested. Where these requirements are not met, the final report must clearly identify the subcontracted data as non-accredited. ALS Environmental-Houston assumes responsibility for the subcontractor's work, except in the case where a client or a regulating authority has specified which subcontractor is to be used.

6.2 SOP HS-GEN007: "Subcontract Sample Submittal" requires that :

6.2.1 clients are notified in advance when test subcontracting is required

6.2.2 all samples are shipped under COC to maintain the integrity of the samples

6.2.3 the subcontract labs must have the required TNI accreditation to process the

submitted samples when TNI accredited testing is requested or other certification if required by QA Plan

6.2.4 results from subcontracted analyses are identified in the final test report

7) Purchasing Services and Supplies

7.1 The laboratory ensures that purchased supplies and services that affect the quality of environmental tests are of the required or specified quality by using approved suppliers and products. The laboratory has procedures for purchasing, receiving, and storage of supplies that affect the quality of environmental tests are found in SOP HS-QS001 Reagent/Standard Receiving and Preparation Tracking. The laboratory test method SOPs, in general, specify the chemicals and grade required by each.

7.2 The Technical Director, QA Manager or a Departmental Manager is responsible for review and approval of service providers supplies and also approves technical content of purchasing documents prior to ordering.

7.3 ALS Environmental - Houston uses vendors which supply the level of quality required to perform testing activities. An Approved Vendor List is maintained in the secured network drive that indicates the basis or bases for approval along with certification status. Relevant certifications are maintained in this system. ALS Environmental - Houston Environmental - Houston maintains a relationship with multiple vendors and uses vendors with comparable certifications or accreditations.

8) Service to the Client

8.1 The laboratory collaborates with clients and/or their representatives in clarifying their requests and in monitoring of the laboratory performance related to their work. Each request is reviewed to determine the nature of the request and the laboratory's ability to comply with the request within the confines of prevailing statutes and/or regulations without risk to the confidentiality of other clients. The laboratory utilizes a number of processes to ensure that adequate resources exist to meet service demands. Senior staff meetings, tracking of outstanding proposals and a current synopsis of incoming work all assist the senior staff in properly allocating sufficient resources. Status/production meetings are conducted daily with the laboratory and Project Managers to inform the staff of the status of incoming work, future projects, and project requirements.

8.1.1 The laboratory actively seeks client feedback, both positive and negative, to identify areas of improvement within the quality system, testing activities and service to the client.

8.1.2 The laboratory will clarify requests if the customer has specified incorrect, obsolete, or improper methods.

8.1.3 The laboratory will notify customers when methods require modifications to ensure achievement of project-specific objectives contained in planning documents (e.g., difficult matrix, poor performing analyte).

8.1.4 The laboratory will communicate with customers when project planning documents (e.g., QAPP or Sampling and Analysis Plan (SAP)) are missing or

requirements (e.g., action levels, detection and quantification capabilities) in the documents require clarification.

8.1.5 The laboratory will notify customers when a problem has been encountered with sampling or analysis that may impact results (e.g., improper preservation of sample).

Laboratory management also monitors a number of other indicators to assess the overall ability of the laboratory to successfully perform analyses for its clients. This includes on-time performance, customer complaints, training reports and non-conformity reports. A frequent assessment is made of the laboratory's facilities and resources in anticipation of accepting an additional or increased workload.

All Requests for Proposal (RFP) documents are reviewed by the Project Manager and appropriate managerial staff to identify any project specific requirements that differ from the standard practices of the laboratory. Any requirements that potentially cannot be met are noted and communicated to the client, as well as requesting the client to provide any applicable project specific Quality Assurance Project Plans (QAPPs).

When a client requests a modification to an SOP, policy or standard specification, the Project Manager will discuss the proposed deviation with the Laboratory Manager, and department supervisors to obtain approval for the deviation. The QA Manager may also be involved. All project-specific requirements must be on-file and with the service request upon logging in the samples. The modification or deviation must be documented. A project-specific communication form, or similar, may be used to document such deviations.

8.2 Client Confidentiality

8.2.1 The laboratory confidentiality policy is to not divulge or release any information to a third party without proper authorization from the client. Third party requests for data and information are referred to the client. Data and records identified as proprietary, privileged, or confidential are exempt from disclosure. All electronic data (storage or transmissions) are kept confidential, based on technology and laboratory limits, as required by client or regulation. The procedures for maintaining client confidentiality are found in SOP HS-GEN004 Client Confidentiality of Electronic Data Transfers.

8.2.2 Communication with the client, or their representative, is maintained to provide proper instruction and modification for testing. Technical staff is available to discuss any technical questions or concerns the client may have.

8.2.3 The client, or their representative, may be provided reasonable access to laboratory areas for witnessing testing.

8.2.4 Delays or major deviations to the testing are communicated to the client immediately by the assigned Project Manager.

8.2.5 The laboratory will provide the client with all requested information pertaining to the analysis of their samples. An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

8.2.6 Any information obtained from or about a customer or regulator will be kept strictly confidential unless sharing has been agreed to by the source.

8.2.7 All personnel including external bodies, contractors or any individual acting on

the laboratory's behalf are required to keep all information obtained or created during the performance of their activities confidential except as required by law.

8.3 Client Feedback

8.3.1 The laboratory seeks both negative and positive feedback following the completion of projects and periodically for ongoing projects. Feedback provides acknowledgement, corrective actions where necessary, and opportunities for continuous improvement. Feedback is obtained via web surveys, the results of which are maintained by marketing and provided to the Lab Director. A link is embedded in the email signature of all employees that regularly engage in communications with clients. An integral part of the client experience is to target recent clients on their recent laboratory experience via the client survey. For surveys with score of 6 or lower, the QA Department will create a correction action report in the NCAR system.

9) Complaints

9.1 The purpose of this section is to assure that customer complaints are addressed and corrected. This includes requests to verify results or analytical data.

9.2 For complaints received directly from a client, the personnel who receives the complaint performs any initial documentation and assessment of the issue to determine if it is related to laboratory activities. Depending upon the nature of the complaint, the Project Manager for that client will be notified of the issue. The project manager will inform the client that the laboratory acknowledges receipt of the complaint and provide regular updates as they arise on the progress of the resolution. Management personnel is responsible for investigating, validating, addressing, following through and correcting the issue. The client will be contacted with a resolution in a timely manner, usually in the form of a formal letter once the complaint has been properly addressed.

9.3 If it is determined that a complaint is without merit, it is documented, and the client is contacted.

9.4 All complaints are entered into the Customer Complaints and Queries (CCQs) database on Sharepoint where they are tracked. If the complaint represents a systemic issue, the CCQ will be linked to an NCAR in the Corrective Action database on Sharepoint.

10) Facilities and Equipment

10.1 The laboratory facilities are designed and organized to facilitate testing of environmental samples. Environmental conditions are monitored to ensure that conditions do not invalidate results or adversely affect the required quality of any measurement.

10.2 ALS Group USA, Corp, Houston facility, is conveniently located in southwest Houston at 10450 Stancliff Road. The current facility has 26,000 square feet, in which 17,000 square feet is associated with laboratory work space, sample receiving and storage areas. Another 8000 square feet contains the HRMS facility (Dioxins & Furans, Perchlorate, Corporate administration). The two floor plans are found in Appendix C.

10.3 Separate work areas, or departments, are designated by application within the facility.

The work space is complimented by special air handling and ventilation capabilities, sophisticated central gas supply, sensitive, modern and automated instrumentation, current data management software and computer hardware. The work area for volatile organic analysis has a separate, dedicated HVAC system. In addition, there are separate secure facilities for sample storage, solvent storage, laboratory inventory and hazardous waste management and storage. Large walking sample refrigerators/freezers are monitored 24 hours by ALS's security company. All large walk coolers/freezers are backed up by a standby natural gas generator, in the event there is a loss of power in the building.

10.4 The laboratory security features provide sample integrity and storage. Staff access to the facility is limited to the front and rear doors and the shipping and receiving door. Visitor access to laboratory is limited to the front entrance or client services door. All visitors must be escorted while on site. Access to ALS complex is controlled by electronic security gates during nonworking hours and holidays.

10.5 Access to the server room is restricted to only the necessary IT personnel, in order to maintain a safe temperature-controlled area. The doors of the server room are kept locked with a cyber lock to prevent unauthorized access.

10.6 Information Technology (IT) and LIMS.

- LIMS for ALS Environmental - Houston HRMS lab is maintained by the LIMS group, located at ALS - Kelso, Washington. The Kelso office is responsible for the upgrades, testing and maintenance such as backup of the server. LIMS for ALS Environmental - Houston Full Service lab is maintained by the LIMS group, located at ALS – Houston, Texas.
- ALS Kelso maintains the server for HRMS LIMS (StarLIMS) at a datacenter in Portland, Oregon. ALS Houston maintains the server for FS LIMS (alphaLIMS, GEL).
- Client must be notified prior to the implementation of a new LIMS or activates that may affect data integrity and security, such as the move of server to a different location, change in LIMS database structure, etc.
- QA Manager or designee must maintain records and notify Management immediately if any electronic data processing issue is identified. This check must be performed with the quarterly 10% data package review.

11) Sample Management

11.1 Chain of Custody

The laboratory does not use legal chain of custody services except when projects request the use of internal chain of custody procedures. Upon request a preprinted Chain-of-Custody is provided, custody seals are sent by the lab for sample cooler if the sampling containers are ordered from the laboratory. If required, custody seals for individual containers are available upon request. Shipping records are maintained with the chain of custody.

11.2 Processes to facilitate and document sample handling and management. The quality of analytical results is highly dependent upon the quality of the procedures used to

collect, preserve, and store samples. Sampling factors that must be taken into account to insure accurate, defensible analytical results include:

11.2.1 Amount of sample taken

11.2.2 Type of container used

11.2.3 Type of sample preservation

11.2.4 Sample storage time

11.2.5 Proper custodial documentation

11.3 ALS – Houston provides clients with appropriate sample collection materials to meets EPA sample collection guidelines. Materials and information provided are:

- Sample collection containers
- Sample bottle labels
- Preservative information
- Chain of custody forms
- Sample shipping containers
- Directions for collection, as needed
- A trip blank if volatile organics are to be collected
- A cooler temperature blank
- Custody seals for the shipping coolers plus individual sample containers, if requested
- Sample receipt policy
- Additional packing material, as needed
- Cooler packing and shipping instructions
- These items are provided as necessary based on client instructions through Project Management. SOP HS-SM002 Bottle Orders, describes procedures to supply clients with the above sample collection materials.

11.4 Sample Storage – The laboratory building is operated under a controlled access security system, where entrance requires use of a magnetic key for employees or and when entry access is granted internally, using an electronic door lock release switch system. The building security ensures that only laboratory employees have access to sample storage areas. For the samples received, specific cooler or freezer storage locations are assigned per SOP HS-SM001 sample receipt and Log –in.- Samples for volatile organic testing are segregated and stored in coolers that are separate from general storage (semi-volatiles, metals, etc.). Refrigerator / Freezer sample storage areas are monitored daily for the required storage temperatures (e.g. above 0 to 6˚C for water samples) according to SOP HS-EQ002 Thermometer Calibration and Temperature Monitoring.

11.4.1 Sample Transfer to subcontracted lab or return to client:

All samples are shipped under COC to maintain the integrity of the samples.

Shipping container must be shipped and packed in accordance with DOT regulations, such DOT approve shipping container, Haz Commination Labeling, etc.

11.5 Sample Disposal – Samples are held in storage for 30 days after invoice date, unless directed otherwise. Disposal of samples follow procedures identified in SOP HS-SAF-001

Hazardous and Non-Hazardous Waste Disposal Procedures. The SOP directs the following:

11.5.1 All Foreign and Regulated soil must be sterilized to comply with USDA Soil import permit requirements.

11.5.2 Neutral, non-hazardous aqueous waste may be disposed into the sanitary sewer system.

11.5.3 Hazardous waste are segregated according to type, stored as per RCRA hazardous storage rule (40 CFR 260-262).

11.5.4 The laboratory is Large Quantity Generator and must comply with TCEQ/EPA/RCRA waste reporting policies.

11.5.5 All Hazardous waste shipments are handled by a RCRA permitted waste transporter.

11.5.6 All Hazardous Waste is only shipped to a RCRA permitted waste disposal facility.

11.6 Sampling Containers

11.6.1 The laboratory offers clean sampling containers for use by clients. Empty containers returned to the lab will be destroyed and client may by charged the cost of the containers.

11.6.2 ALS does not provide sampling services. The laboratory's responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, and packing materials required to properly preserve, pack, and ship samples to the laboratory.

11.6.3 All preserved sample containers must be labeled in accordance Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

11.7 Sampling Containers, Preservation Requirements, Holding Times

11.7.1 See Appendix D for Sampling Containers, Preservation Requirements and Holding Time. If preservation or holding time requirements are not met, the procedures in Section 15 – "Control of Nonconforming Environmental Testing Work" are followed.

11.8 Samples are logged into a Laboratory Information Management System (LIMS). Potential problems with a sample shipment are addressed by contacting the client and discussing the pertinent issues. When the Project Manager and client have reached a satisfactory resolution, the login process may continue and analysis may begin. During the login process, each sample container is given a unique laboratory code and a service request form is generated. The LIMS generates a Service Request that contains client information, sample descriptions, sample matrix information, required analyses, sample collection dates, analysis due dates and other pertinent information. The service request is reviewed by the appropriate Project Manager for accuracy, completeness, and consistency of requested analyses and for client project objectives.

12) Analytical Procedures

All methods must be validated before they are put into use. Sources of methods employed are based on published methods. The following elements of method validation are: Demonstration of Capability, On-going proficiency, Initial Test Method Evaluation, Estimation of Uncertainty and Laboratory-Developed or Non-Standard Method Validation and Control of Data.

12.1 Initial Demonstration of Capability (IDOC) is a procedure to establish the ability of the analyst to generate data of acceptable accuracy and precision in a specific matrix. This procedure requires the preparation and analysis of a known concentration of each analyte spiked in four separate aliquots of laboratory pure matrix. These samples are carried through the entire preparation and analytical procedure. The resulting recovery and the standard deviation are determined and compared to specified limits. This IDOC must be made at any time there is a significant change in instrument type, personnel or test methods. For analytes that do not lend themselves to spiking, the demonstration of capability may be performed using quality control samples. In cases of analytes for which spiking is not an option and for which quality control samples are not readily available, the procedure published in 40 CFR Part 136, Appendix A, test methods, is one way to perform this demonstration. The data for the DOC procedure is evaluated by either the section supervisor or the QA Department. Documentation for analyst IDOCs are maintained on the laboratory network by the QA Department as stored in analyst training records. After successful completion of the IDOC or on-going DOCs, certification statements are prepared and reviewed for approval by the Technical Director and the QA Manager.

12.2 On-going Proficiency-Annual ongoing DOCs are performed when either an analyst repeats the DOC annually or generates acceptable results when analyzing performance evaluation samples. All analysts, primary and backup must maintain yearly DOCs. The data for the DOC procedure is evaluated by either the section supervisor or the QA Department. Per TNI criteria, if DOCs lapse past one calendar year, analyst must perform IDOC prior to analyzing client samples or PT samples.

12.3 Initial Test Method Evaluation – This matrix-specific evaluation involves the determination of the Limit of Detection (LOD), confirmation of the Limit of Quantitation (LOQ), an evaluation of precision and bias, and an evaluation of the selectivity of the method.

12.3.1 The Limit of Detection (LOD) defines a range below the LOQ where detections must be reported with the data qualifier “J”, indicating the value reported is an estimated value. The LOD is an estimate of the minimum amount of a substance that an analytical process can reliably detect. The LOD is analyte- and matrix-specific and may be laboratory-dependent. The LOD is used to verify an MDL study. Further discussion of LOD is found in SOP HS-QS006 Limit of Detection (LOD) - Limit of Quantitation (LOQ) . LODs are analyzed on a quarterly basis.

12.3.2 The Limit of Quantitation (LOQ) for an analytical method is established to be no lower than the lowest non-zero calibration standard for the determinative method. The LOQ defines the lower limit for an analyte working range where data may be reported without qualification. On a final analytical report, the LOQ may be labeled as the method quantitation limit (MQL) or practical quantitation limit (PQL). LOQs are are analyzed on a quarterly basis.

12.3.3 Evaluation of Precision and Bias: Precision and Bias are determined for

standard and non-standard methods, where:

12.3.3.1 Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms.

12.3.3.2 Bias is the systematic error that contributes to the difference between the mean of a significant number of test results and the accepted reference value.

12.3.3.3 Precision and bias criteria are based upon evaluation of control chart limits or based upon approved program limits (e.g. TCEQ QAPP for Superfund control limits). When criteria are not documented, they are determined through the performance of a Demonstration of Capability.

12.3.3.4 Precision and bias using non-standard, modified standard or laboratory-developed methods are compared to the criteria established by the client (when requested), the method, or the laboratory.

12.3.4 Evaluation of the Selectivity of the Method – This evaluates selectivity of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. The laboratory evaluates selectivity through procedures defined in the test method SOPs such as use of dual columns, interference checks, and analysis of method required QC samples (e.g. blanks, LCS, etc).

12.4 Estimation of Uncertainty – An Estimation of uncertainty consists of the sum (combining the components) of the uncertainties of the numerous steps of the analytical process, including, but not limited to, sample plan variability, spatial and temporal sample variation, sample heterogeneity, calibration/calibration check variability, extraction variability, and weighing variability. To the degree where the laboratory has a control over these processes, the laboratory estimates uncertainty using the standard deviation calculated from routine quality control samples (e.g. the LCS) See SOP HS-QS024.

12.5 Control of Data: All calculations and all relevant data are subject to appropriate checks in a systematic manner that is addressed in the following laboratory SOPs:

12.5.1 SOP HS-IT001 LIMS Raw Data and Data Integrity, for the validation of software applications associated with data acquisition, calculation and reporting;

12.5.2 SOP HS-QS009 Data Reduction, Review and Validation, for procedure to insure that reported data are free from transcription and calculation errors and for procedures to address manual calculations, ”reasonableness” of results, verification of manual integration, etc.

12.5.3 SOP HS-QS016 Manual Integration Policy, for procedures for manual integrations;

12.5.4 SOP-HS-IT002 and HS-IT007 Computer Software Installation and Maintenance, and Software Testing assures that computers, user-developed computer software, automated equipment, or microprocessors used for the acquisition, processing, recording, reporting, storage, or retrieval of environmental test

data are properly installed and tested to document all computers and related software in use are validated as being adequate for use and:

12.5.4.1 Protected for integrity and confidentiality of data entry or collection, data storage, data transmission and data processing.

12.5.4.2 Maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of environmental test data.

12.5.4.3 Held secure including the prevention of unauthorized access to, and the unauthorized amendment of, computer records.

12.6 General Equipment Requirements include the following:

12.6.1 The laboratory has all the necessary equipment required for the correct performance of the scope of environmental testing presented in this Quality Manual.

12.6.2 All equipment and software used for testing and sampling is capable of achieving the accuracy required and complies with the specifications of the environmental test method as specified in the laboratory SOP.

12.6.3 Equipment is operated only by authorized and trained personnel.

12.6.4 Up-to-date instructions on the use and maintenance of equipment are readily available for use by laboratory personnel, including any relevant manuals provided by the manufacturer of the equipment.

12.6.5 SOP HS-QS-005 Validation of New Instrumentation and New Methods requires that all equipment is calibrated or checked, MDLs performed and Precision and Accuracy confirmed before being placed into use. This ensures that it meets laboratory specifications and the relevant standard specifications of the application.

12.6.6 SOPs HS-IT003 IT System Security, HS-IT007:Software Testing, HS-IT008: Software Development Methodology, and HS-IT009: Software Change Control are a part of the quality system to ensures that test equipment, including hardware and software, are safeguarded from adjustments which would invalidate the test results. This is accomplished by limiting access to the equipment and using password protection where possible. These SOPs also provide instructions for requesting, authorizing, testing, approving, implementing and establishing the priority of software change and software version control.

12.6.7 Equipment that has been subject to overloading, mishandling, given suspect results, or been shown to be defective or outside specifications are: taken out of service, isolated to prevent its use, and clearly labeled as out of service until it has been shown to function properly. If it is shown that previous tests are affected, then procedures for non-conforming work must be followed.

12.6.8 SOP HS-EQ004 Preventative Maintenance also requires each item of equipment and the software used to generate test results be uniquely identified and records of equipment maintenance and software installed be maintained. Maintenance Logbooks are assigned to each instrument for the purpose of documenting maintenance activities. This information includes the following:

- Identity of the equipment and its software.
- Manufacturer's name, type identification, serial number or other unique identifier.
- checks that equipment complies with specifications of applicable tests;
- Current location.
- manufacturer's instructions, if available, or a reference to their location
- dates, results and copies of reports and certificates of all calibrations, adjustments, acceptance criteria, and the due date of next calibration.
- Maintenance plan where appropriate, and maintenance carried out to date; documentation on all routine and non-routine maintenance activities and reference material verifications.
- Any damage, malfunction, modification or repair to the equipment;
- date received and date placed into service (if available); and
- Condition when received, if available (new, used, reconditioned).
- Instrument status – Date taken out of service and date return to service.

12.7 Support Equipment Calibration – Various types of support equipment have calibration verification requirements based upon application. Refer to Appendix G.

12.8 Instrument Calibration Procedures –,

12.8.1 Initial Calibrations – In general, all initial calibrations are according to method requirements described in the laboratory method SOP. The SOPs require the use of a second source calibration verification standard, acquired from a different vendor or different lot if the same vendor. The calibration type (internal, external) and the calibration model options are described in the SOPs. The following general rules must be followed for all multi-point initial calibrations:

12.8.1.1 Select points from the middle of the curve may not be dropped in order to achieve acceptance criteria.

12.8.1.2 If the low or high calibration point is dropped from the curve, the working curve is adjusted and sample results outside the curve are qualified or re-analyzed at dilution.

12.8.1.3 Sufficient raw data records are retained to allow reconstruction of each initial calibration.

12.8.2 Continuing Calibration Verification and frequency are performed according to method requirements. Refer to analytical SOPS for established acceptance criteria. The following general rules must be followed for continuing calibration verifications:

12.8.2.1 Continuing Calibration Verification (CCV) & Continuing Calibration Blank (CCB) is performed at the beginning, after every ten samples, and end of each analytical batch. Methods employing internal standards require continuing calibration verifications to be analyzed at the beginning of each analytical batch or as required by the determinative method, whichever is more restrictive. NOTE: Some programs require closing CCV even for internal standard calibration, please consult Supervisor or QA. Other programs may require Continuing Calibration Blank (CCB) to be paired with the CCV.

Continuing instrument calibration verification is performed whenever it is expected that the analytical system may be out of calibration or might not meet verification acceptance criteria.

12.8.2.2 Continuing instrument calibration verification is performed when the time period for calibration or the most recent calibration verification has expired.

12.8.2.3 Continuing instrument calibration verification is performed for all analytical systems that have a calibration verification requirement.

12.8.2.4 Calibration is verified for each compound, element, or other discrete chemical species.

12.8.2.5 The calculations and associated statistics for continuing instrument calibration are included or referenced in the test method SOP.

12.8.2.6 Sufficient raw data records are retained to allow reconstruction of the continuing instrument calibration verification. Continuing instrument calibration verification records connect the continuing verification date to the initial instrument calibration.

12.8.3 Unacceptable Continuing Instrument Calibration Verifications: If routine corrective action for continuing instrument calibration verification fails to produce subsequent consecutive (immediate) calibration verification within acceptance criteria, then a new calibration is performed or acceptable performance is demonstrated after corrective action with two consecutive calibration verifications.

12.8.3.1 For any samples analyzed on a system with an unacceptable calibration, some results may be useable if qualified and under the following conditions:

12.8.3.1.1 If the acceptance criteria are exceeded high (high bias) and the associated samples are below detection, then those sample results that are non-detects may be reported as non-detects.

12.8.3.1.2 If the acceptance criteria are exceeded low (low bias) and there are samples that exceed the maximum regulatory limit, then those exceeding the regulatory limit may be reported.

12.8.4 Corrective Actions for Calibration – see individual analytical SOPs.

12.9 Major Equipment List: For a list of test equipment in use, refer to the Master Equipment List maintained by the Quality Assurance Department on the ALS Environmental – Houston secure network.

13) Measurement Traceability and Calibration

13.1 Measurement Quality Assurance comes in part from traceability of standards to standard reference materials. To achieve traceability, the following are performed:

13.1.1 All equipment used for generation of test results, including equipment for subsidiary measurements, must be calibrated prior being put into service and

on a continuing basis.

13.1.2 Calibration standards must be traceable to certified reference materials of known quality, where available, for the preparation of the calibration standard(s);

13.1.3 For standards in use for calibration, second source standards are also acquired, to verify the calibration standards in use.

13.1.4 SOP HS-QS001 Chemical Purchase & Receipt; Chemical Preparation, Storage & Tracking describes the laboratory procedures for documenting chemical reference standards purchased for use in the laboratory and procedures for tracking chemical standards and solutions prepared in house. ..

The following records are kept for purchased standards:

Assignment of a unique tracking ID,
Standard name,
Manufacturer name or vendor name,
Certificate of analysis or purity (if available),
Lot ID,
Receipt date,
Expiration date,
Standard storage requirements are specified in the method SOPs.

13.1.5 The following records are kept for solutions prepared in house:

An assignment of a unique tracking ID,
The tracking IDs of stock standards or reagents used in the preparation,
Amounts and concentration of standards used,
The final volume and concentration,
Date prepared
An assigned expiration data (as per stability of the analyte based on the method / manufacturers expiration date, etc) and
Identification of the analyst associated with the preparation,
Standard storage requirements are specified in the method SOPs.

13.1.6 When traceability of measurements to SI units is not possible or not relevant, evidence for correlation of results through inter laboratory comparisons, proficiency testing, or independent analysis may be provided.

13.1.7 Equipment used for generation of test results are calibrated according to the minimum frequency identified in the laboratory SOP, as specified by the method, the manufacturer, by regulation, or as needed.

13.1.8 Additionally, clients may further verify a required level of uncertainty is achieved by: a review of internal quality control data, provided as requested by a client; and through a use of a third party data validation service, to review the data (as requested by a client).

13.1.9 Reference Material requirements for the Metrology equipment (analytical balances, thermometers, etc.) are identified is SOP HS-EQ001 Use and Maintenance of Balances - SOP HS-EQ002 Thermometer Calibration and Temperature Monitoring and SOP HS-EQ003 Lab Volumetric Ware Calibration.

13.1.9.1 SOP HS-EQ001 requires the annual analytical balance service and calibration verification using an outside service. Class 1 weights are

used for daily calibration verifications of analytical balance bracketing the range of use. Class 1 weights must be certified every year.

13.1.9.2 SOP HS-EQ002 requires that NIST-traceable Reference thermometers calibrations be verified every 5 years by a NVLAP calibration laboratory. Thermometers in use for various temperature monitoring activities (e.g. storage refrigerators, drying ovens, etc.) are verified for accuracy annually using the NIST-traceable reference thermometers at temperature bracketing the monitored range. Digital thermometers are verified for accuracy quarterly using the NIST-traceable reference thermometers at temperatures bracketing the monitored range.

13.1.9.3 SOP HS-EQ003 requires at least five measurements quarterly (for DoD projects, three measurements daily), and the precision, bias and individual % Recovery calculated and recorded. All volumetric labware shall be initially and thereafter annually inspected for possible defects.

13.2 Source and Preparation of Standards and Reference Materials

13.2.1 Consumable reference materials routinely purchased by the laboratories (e.g., analytical standards) are purchased from nationally recognized, reputable vendors. All vendors have fulfilled the requirements for ISO 9001 certification and/or are accredited by a TNI-approved third party accreditor. The laboratory relies on a primary vendor for the majority of its analytical supplies. Consumable primary stock standards are obtained from certified commercial sources or from sources referenced in a specific method. Cambridge Isotope Laboratories (CIL), Wellington Laboratories, and Accustandard are examples of the vendors used. Reference material information is recorded in the “Materials Logbook” in LIMS and materials are stored under conditions that provide maximum protection against deterioration and contamination. Entries in the Materials Logbook include such information as an assigned LIMS identification code, the source of the material (i.e. vendor identification), solvent (if applicable) and concentration of analyte(s), reference to the certificate of analysis and an assigned expiration date. The date that the standard is received in the laboratory is marked on the container. When the reference material is used for the first time, the date of usage and the initials of the analyst are also recorded on the container.

13.2.2 Stock solutions and calibration standard solutions are prepared fresh as often as necessary according to their stability. All standard solutions are properly labeled as to analyte concentration, solvent, date, preparer, and expiration date; these entries are also recorded in the appropriate notebook(s) following the SOP HE-EXT006, *Preparation of Standard Solutions* or HS-QS001, *Reagent/Standards Receiving and Preparation* and are entered in to LIMS for tracking purposes. Prior to sample analysis, all calibration reference materials are verified with a second, independent source of the material.

13.3 High Resolution GC/MS Systems

13.3.1 All HRGC/HRMS instruments are calibrated at a minimum of five different concentration levels for the analytes of interest (unless specified otherwise)

using procedures outlined in Standard Operating Procedures and/or appropriate USEPA method citations. All reference materials used for this function are vendor-certified standards. Calibration verification is performed at method-specified intervals following the procedures in the SOP and reference method. For isotope dilution procedures, the internal standard response(s) and labeled compound recovery must meet method criteria. Method-specific instrument tuning is regularly checked using perfluorokerosene (PFK). Mass spectral peaks for the tuning compounds must conform both in mass numbers and in relative intensity criteria before analyses can proceed.

14) Assuring the Quality of Results

14.1 The quality of test results are defined by the use, collection, and monitoring of essential quality control elements of the test procedures. Procedures employed to accomplish this may include the following:

14.1.1 Defining acceptance criteria based upon method defined criteria, which may be static (e.g. ±20%) or statistically derived (e.g. ± 3 standard deviations from a mean). Acceptance criteria for the testing procedures are typically defined by the QC sample type (ICV, CCV, LCS, MS, etc.) and are in general based on either defined method criteria or a statistical method.

- Acceptance criteria and frequency for calibration and calibration verifications by method are found in the associated method SOP or in LIMS.
- Acceptance criteria and frequency for Laboratory Control Samples (LCS) by method are found in the associated method SOP or in LIMS.

14.1.2 Control Charting and Trending

14.1.2.1 In addition to evaluating individual batch QC results against control limits, QC results from successive batches are also evaluated for possible trends. While a trend is not necessarily an out-of-control situation, it can provide an early warning of a condition that can cause the system to go out of control. ALS SOP HS-QS024 “Trending, Control Limits, and Uncertainty” describes in detail the assessment of QC data in the laboratory. The following conditions are trends that may initiate action and/or monitoring.

- A series of successive points on the same side of the mean
- A series of successive points going in the same direction
- Two successive points between warning limits and control limits

14.1.2.2 ALS relies on analytical staff to identify trends in analytical systems. Quality Assurance can produce control charts as needed to assess trends but this activity by QA is not preventive and is only used to verify trends exist. The occurrence of a trend does not invalidate data that are otherwise in control. However, trends do require attention to determine whether a cause can be assigned to the trend so that appropriate preventive action can be undertaken.Participation

in semi-annual Proficiency Test studies (per matrix) provides data to assess the validity of the testing procedures employed.

14.1.3 Replicate tests using the same or different methods.

14.1.4 Retesting of retained samples to confirm analysis

14.1.5 Correlation of results for different characteristics of a sample.

14.1.6 The required use of second source calibration verification standards ensure the quality of reference materials used to prepare calibrations and other quality control samples employed in the testing processes.

14.1.7 All Test and Preparation SOPs define the quality control samples that are required in the test processes, based on the most restrictive requirements of an analytical methods, regulatory requirements, or internally generated QC criteria. When the most restrictive criteria are not apparent, the mandated method or regulatory criteria is employed. These QC samples include:

14.1.7.1 Initial Calibration Standards defined and acceptable calibration models and criteria

14.1.7.2 Initial Calibration Verification and Continuing Calibration criteria and frequency

14.1.7.3 Calibration or instrument blanks acceptance criteria and frequency

14.1.7.4 Method Blanks acceptance criteria and frequency Laboratory Control Samples acceptance criteria and frequency

14.1.7.5 Duplicate acceptance criteria (whether as sample, LCSD or MSD)

14.1.7.6 Interference checks as defined by a method

14.1.7.7 Internal / external calibration criteria as per method

14.1.7.8 Quality of reagents or solvents use to prepare standards and samples

14.1.7.9 Evaluation of method capability through limit of detection evaluation and analyst demonstration of capability

14.1.8 Employment of Positive and Negative control for Testing Procedures – The following are procedures employed as negative or positive:

14.1.8.1 Blanks (negative)

14.1.8.2 Laboratory control sample (positive)

14.1.9 Method Selectivity is assured through:

14.1.9.1 Absolute and relative retention times in chromatographic analyses;

14.1.9.2 Two-column confirmation when using non-specific detectors (e.g. dual ECD);

14.1.9.3 Use of acceptance criteria for mass-spectral tuning (found in test method SOPs);

14.1.9.4 Use of the correct method, according to its scope assessed during method validation.

14.2 Laboratory Quality Control Batch Sample types and typical corrective actions – (see

Batch Definition in Appendix A). These essential Quality Control components are processed in exactly the same manner as field samples.

14.2.1 Method Blanks (MB) –

14.2.1.1 MB is prepared from analyte free water (or other acceptable analyte free matrix)

14.2.1.2 Contaminated blanks are identified according to the acceptance limits in the test method SOPs, typical criteria <1/2 LOQ or < LOQ if a common lab contaminant (e.g. methylene chloride for VOC analysis).

14.2.1.3 When a blank is determined to be contaminated, the cause must be investigated and measures taken to minimize or eliminate the problem.

14.2.1.4 Batch Data that are unaffected by the blank contamination (non-detects or other analytes) are reported unqualified.

14.2.1.5 Batch Sample data that are suspect due to the presence of a contaminated blank are reanalyzed, qualified, or not reportable.

14.2.2 Laboratory Control Samples (LCS)

14.2.2.1 LCS are prepared from analyte free water (or other acceptable analyte free matrix), and spiked with verified and known amounts of analytes for the purpose of establishing precision or bias measurements.

14.2.2.2 LCS are analyzed at a frequency mandated by method, regulation, or client request, whichever is more stringent (1 per batch of 20 or less depending on the method is the practice in the laboratory SOPs as per method).

14.2.2.3 LCS data is calculated in percent recovery that allows comparison to established acceptance criteria.

14.2.2.4 When the LCS does not meet criteria, the cause must be investigated and measures to correct the problem must be taken.

14.2.2.5 For any batch samples analyzed with the unacceptable LCS, some results may be useable if qualified and under the following conditions:

- If the acceptance criteria are exceeded high (high bias) and the associated samples are below detection, then those sample results that are non-detects may be reported as non-detects.
- If the acceptance criteria are exceeded low (low bias) and there are samples that exceed the maximum regulatory limit, then those exceeding the regulatory limit may be reported.

14.2.2.6 For those batch samples having unusable data, reprocessing and reanalysis is required (after the cause of the LCS failure has been corrected),

14.2.2.7 Should re-analysis be an impossibility, any data reported must be qualified and discussed in the data report narrative to the client

14.2.3 Matrix Spikes and Matrix Spike Duplicates - prepared from a portion of client

sample, and spiked with verified and known amounts of analytes for the purpose of evaluating the effect of sample matrix on the test measurements.

14.2.3.1 The MS are analyzed at a frequency mandated by method, regulation, or client request, whichever is more stringent (1 per batch of 20 or less is the practice in the laboratory SOP as per most method).

14.2.3.2 MS are calculated in percent recovery that allows comparison to established acceptance criteria (the LCS criteria is utilized for most methods).

14.2.3.3 When the MS does not meet criteria, it is evaluated in comparison with the LCS to assess whether there is a matrix effect present. A reproducible duplicate MS (the MSD) would assist the confirmation that a matrix effect is likely present.

14.2.3.4 For any batch samples analyzed with the unacceptable MS, like the LCS some results may be useable under the following conditions:

- If the acceptance criteria are exceeded high (high bias) and the associated samples are below detection, then those sample results that are non-detects may be reported as non-detects.
- If the acceptance criteria are exceeded low (low bias) and there are samples that exceed the maximum regulatory limit, then those exceeding the regulatory limit may be reported.

14.2.3.5 All batch samples associated with a MS outside of criteria are identified for the client or program data usability decisions. The cause of an MS exceedance may be due to many reasons, most often due to an interference present that is not easily removed by a practice stated in the method. In these cases, the data is reported with the qualified MS results and noted on a laboratory data review checklist exception report.

14.2.4 Duplicates - prepared from a portion of client sample, for the purpose of evaluating method precision.

14.2.4.1 The duplicate is analyzed at a frequency mandated by method, regulation, or client request, whichever is more stringent (1 per batch of 20 or less is the practice in the laboratory SOP as per most methods). The duplicate may take the form as a duplicate, a matrix spike duplicates (MSD), or a laboratory control sample duplicate, depending on the availability of additional sample and the type of test method.

14.2.5 Surrogate Spikes - Surrogates are substances with chemical properties and behaviors similar to the analytes of interest used to assess method performance in individual samples.

14.2.5.1 Surrogates are added to all samples (in test methods where surrogate use is appropriate) prior to sample preparation or extraction.

14.2.5.2 Surrogate recovery results are compared to the acceptance criteria as established in the test method SOP or from program guidance (CLP or DOD) or from laboratory established limits.

14.2.5.3 For surrogate results outside established criteria, data is evaluated to determine the impact. Corrective actions include reprocessing and reanalysis to determine whether a matrix effect is present, qualifying the data and/or narrating the occurrence on the data review checklist exception report.

14.3 Proficiency Test Samples - The laboratory participates in proficiency test (PT) studies twice a year. These studies include all applicable fields of proficiency testing and are obtained from an approved proficiency test provider.

14.3.1.1 The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

14.3.1.2 Proficiency Testing (PT) samples are treated as typical samples in the normal production process including the same preparation, calibration, quality control and acceptance criteria, sequence of analytical steps, number of replicates, and sample log-in. PT samples are not analyzed multiple times unless routine environmental samples are analyzed multiple times.

14.3.1.3 The laboratory initiates corrective action procedures for any unacceptable PT result. Additionally, the laboratory must successfully complete two of the most recent three proficiency tests for each field of proficiency testing. In the event that this requirement is not met, the laboratory institutes corrective action procedures, including participation in 2 supplemental PT studies to demonstrate corrective action. Supplemental PT studies are performed at least 15 days apart from each other.

- For a PT studies, a “Not Acceptable” result for any analyte on two of the most recent PT studies results in a “Fail” score for that analyte.

14.4 Data Review - The laboratory reviews all data generated in the laboratory, hardcopy and electronic, for compliance with method, and, whereapplicable, client requirements. Procedures for Data Reduction, Review and Validation are described in SOP HS-QS009.. In general, the procedure includes:

14.4.1.1 Initial analyst calibration, and applicable batch QC data (method blank, LCS, MS, Duplicate, etc,), including the raw data and calculated data entered into the lab LIMS. Batch QC limits by method are stored in LIMS to facilitate checks for meeting Batch QC acceptance limits by method. The LIMS also contains LOQ and LOD information along with upper calibration limits by method, to facilitate accurate evaluation of detections against the method applicability range for reporting, to ensure required dilutions were performed and reported correctly, when necessary. The initial process includes the use of LIMS QC Checking tools that the analyst and any later peer reviewer can use to evaluate whether reportable client data entered in LIMS is correctly referenced (or linked) to the correct supporting QC data. A Data Assessment checklist is prepared during the initial review of the data by the analyst.

14.4.1.2 A second peer review is performed by a qualified analyst or supervisor. The same LIMS QC checks are reviewed and include search for the required QC sample types to assure that all supporting QC data are present in LIMS for evaluation against the QC acceptance criteria stored in LIMS for each test performed. A nominal 10 % of the raw data is reviewed to verify the correct data has been calculated and entered correctly.

14.4.1.3 QC exceedances are identified in LIMS by the application of the appropriate data qualifying flags. A list of the most common data qualifiers can be found in Appendix E. The data qualifying flags may either initiate corrective actions for nonconforming data and/or require supporting comment information to be entered into LIMS batch report or entered into the batch data review checklist exception report

14.4.1.4 Comments for data flags are documented in LIMS and in the batch data review checklist exception report for inclusion in the project Case Narrative, as necessary.

14.4.1.5 A Final Project Manager review of the data is performed to review the data for completeness against any client specified requirements, evaluate the reasonableness of results and prepare a narrative to discuss any anomalies associated with assigned data flags.

14.4.1.6 QA Department reviews data as appropriate and during internal method audits.

15) Control of Non-Conforming Environmental Testing Work

The laboratory takes all appropriate steps necessary to ensure all sample results are reported with acceptable quality control results. When sample results do not conform to established quality control procedures, responsible management will evaluate the significance of the nonconforming work and take corrective action to address the nonconformance.

Non-conforming work is work that does not meet acceptance criteria or requirements. Non-conformances can include unacceptable quality control results or departures from standard operating procedures or test methods. Requests for departures from laboratory procedures are approved by Quality Assurance Manager or the Technical Director and documented, see SOP HS-GEN005, Departures from Approved Procedures.

The policy for control of non-conforming work is to identify the non-conformance, determine if it will be permitted, and take appropriate action. All employees have the authority to stop work on samples when any aspect of the process does not conform to laboratory requirements.

The responsibilities and authorities for the management of non-conforming work are detailed in SOP HS-QS003: “Nonconformance and Corrective Action Procedure”. The laboratory evaluates the significance of the nonconforming work, and takes corrective action immediately, when necessary. The client is notified if their data has been impacted. Resumption of work after non-conformance is authorized by the Quality Assurance Manager or the Technical

Director.

For nonconforming work performed by vendors, for example calibrations, the nonconforming items are checked and deviations if any recorded by the personnel who requested the test. Tested items that do not conform to specifications will not be used in the performance of analysis for any lab data.

16) Corrective Action and Preventive Action.

16.1 **Corrective action** is the action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence.

16.1.1 Deficiencies cited in external assessments, internal quality audits, data reviews, customer feedback/complaints, control of nonconforming work or managerial reviews are documented and require corrective action. Corrective actions taken are appropriate for the magnitude of the problem and the degree of risk.

16.1.2 Any of the Technical Staff (e.g. an analyst, supervisor or project manager) may initiate a corrective action when performing a routine data review. All deficiencies are investigated and a corrective action plan developed and implemented if determined necessary. The implementation is monitored for effectiveness. Corrective action reporting for routine, non-recurring exceedances can be records in logbooks, email, or other informal documents. More serious corrective actions require a more formal corrective action report that is reported to the QA department for monitoring as per SOP HS-QS003: "Nonconformance and Corrective Action Procedure". The QA Manager is responsible for monitoring and recording corrective actions in these cases in the ALS Global Sharepoint website. Specific corrective action protocols specified in test methods may over-ride general corrective action procedures specified in this manual.

16.1.3 Selection and Implementation of Corrective Actions: Once an exceedance or nonconformance is noted, the first action is an investigation to determine the root cause. The root cause is investigated to define the condition or event that, if corrected or eliminated, would prevent the recurrence of the noted deficiency. Based on the root cause investigation potential corrective actions, most likely to prevent recurrence of the nonconformance, are identified. Records are maintained of non conformances requiring corrective action to show that the root cause(s) was investigated, and includes the results of the investigation where uncertainty arises regarding the best approach for analysis of the cause of an exceedance that require corrective action, the appropriate personnel (e.g. The Technical Director or a Department Supervisor) will recommend corrective action to be initiated and completed within the agreed upon time frame.

16.1.4 Monitoring of Corrective Action: Corrective actions are monitored to ensure the successful implementation of changes in laboratory processes as a result of a corrective action plan. Monitoring is executed by the QA Manager, in cooperation with the Department Supervisor. Department supervisors are responsible for monitoring corrective actions associated with routine laboratory activities, including implementation of procedural changes as

stated in the appropriate SOP. Serious corrective actions, those related to systematic problems, are monitored by the QA Manager. All monitoring of Corrective Actions is documented through the NCAR database in Sharepoint. All tracking of NCARs is accomplished though use of Microsoft Teams. This keeps all stakeholders up-to-date on the status of NCARs.

16.1.5 Additional Audits: Additional audits are required when non conformances or departures cast doubt on the laboratory's compliance with approved policies and procedures, or with standards on which these policies and procedures are based (i.e., TNI Standard, or DOD Standard). These audits are conducted as soon as possible according to SOP HS-QS012 Internal Auditing.

16.1.6 Technical Corrective Actions: A cause analysis in corrective action investigates the root cause of the problem. Sample data associated with an exceeded quality control are evaluated for the need to be reanalyzed or qualified. Unacceptable quality control results are documented, and if the evaluation requires cause analysis, the cause and solution are recorded. The analyst is responsible for initiating or recommending corrective actions and ensuring that exceedances of quality control acceptance criteria are documented. Analysts routinely implement corrective actions for data with unacceptable QC measures. First level correction may include re-analysis without further assessment. If the test method SOPs addresses the specific actions to take, they are followed. Otherwise, corrective actions start with assessment of the cause of the problem. Area supervisors review corrective action results and suggest improvements, alternative approaches, and procedures where needed.

16.1.7 If the data reported are affected adversely by the nonconformance, the client is notified in writing. The discovery of a non-conformance for results that have already been reported to the client must be immediately evaluated for significance of the non-conformance, its acceptability to the client, and determination of the appropriate corrective action. Where possible, samples are reported only if all quality control measures are acceptable. Where unacceptable, quality control measures must be reported, all sample associated with the failing control measures are reported with the appropriate data qualifiers.

16.1.8 Departures from Approved Procedures: SOP HS-GEN005, Departures from Approved Procedures allows exceptionally permitting departures from documented policies and procedures, the laboratory allows the release of non-conforming data only with approval by the Technical Director or his designee on a case-by-case basis (e.g. meeting a client specification). Planned departures from procedures or policies do not require audits or investigations. Permitted departures for non-conformances, such as QC exceedances, are fully documented and include the reason for the departure, the affected SOP(s), the impact of the departure on the data, and the data. Refer to.

16.2 **Preventative action** is a pro-active process to identify opportunities for improvement, rather than a reaction to the identification of problems or complaints. The process maximizes the quality of service provided by the laboratory.

16.2.1 Opportunities for improvement and potential sources of non conformances, either technical or concerning the quality system, are proactively identified through various actions including, but not limited to, review of QC data to

identify quality trends (SOP HS-QS004 Control Charts), regularly scheduled staff quality meetings (SOP HS-GEN-006 Resource Review), and annual managerial reviews (SOP HS-QS017 Management Review), scheduled instrument maintenance (SOP HS-EQ004 Preventative Maintenance), running a new LIMS system in tandem with the old system to assure at least one working system (SOP HS-IT002 Computer Software Installation and Maintenance) and other actions taken to prevent problems.

16.2.2 Once potential preventive actions are identified, an action plan is developed, implemented, and monitored to reduce the likelihood of the nonconformance occurrence and to tack advantage of the opportunity for improvement.

16.2.3 All employees have the authority to recommend preventive action procedures, however management is responsible for implementing and monitoring the effectiveness of preventive actions.

17) Control of Records

Laboratory records are a subset of documents, usually data recordings that include annotations, such as daily refrigerator temperature recordings, raw data entered laboratory logbooks, spreadsheets, analyst notes on a chromatogram, and copies of test reports, etc. Records may be on any form of media, including electronic and hard copy. Records allow for the historical reconstruction of laboratory activities related to sample handling and analysis.

17.1 Records Maintained

Records of all procedures to which a sample is subjected while in the possession of the laboratory are kept. The laboratory retains all original observations, calculations and derived data (with sufficient information to produce an audit trail), calibration records, personnel records and a copy of the test report for a minimum of ten (10) years from generation of the last entry in the records. At a minimum, the following records are maintained by the laboratory to provide the information needed for historical reconstruction:

All raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' worksheets and data output records (chromatograms, strip charts, and other instrument response readout records);

17.1.1 A written description or reference to the specific method(s) used, which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value (a copy of all pertinent Standard Operating Procedures);

17.1.2 Laboratory sample ID code;

17.1.3 Date of analysis;

17.1.4 Time of analysis is required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., extractions and incubations);

17.1.5 Instrumentation identification and instrument operating conditions/parameters (or reference to such data);

17.1.6 All manual calculations (including manual integrations);

17.1.7 Analyst's or operator's initial/signature or electronic identification;

17.1.8 Sample preparation, including cleanup, separation protocols, ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;

17.1.9 Test results (including a copy of the final report);

17.1.10 Standard and reagent origin, receipt, preparation, and use;

17.1.11 Calibration criteria, frequency and acceptance criteria;

17.1.12 Data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;

17.1.13 Quality control protocols and assessment;

17.1.14 Electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries;

17.1.15 Method performance criteria including expected quality control requirements;

17.1.16 Proficiency test results;

17.1.17 Records of demonstration of capability for each analyst;

17.1.18 Record of names, initials, and signatures for all individuals who are responsible for signing or initialing any laboratory record;

17.1.19 Correspondence relating to laboratory activities for a specific project;

17.1.20 Corrective action reports;

17.1.21 Preventive action records;

17.1.22 Copies of internal and external audits including audit responses;

17.1.23 Copies of all current and historical laboratory SOPs, policies and Quality Manuals, both electronic and original hard copies;

17.1.24 Sample receiving records (including information on any inter laboratory transfers);

17.1.25 Sample storage records;

17.1.26 Data review and verification records;

17.1.27 Personnel qualification, experience and training records;

17.1.28 Archive records; and

17.1.29 Management reviews.

17.2 Records Management and Storage

These procedures are described in more detail in Laboratory SOPs HS-QS011 for Record Archival Procedures and HS-QS014, Document Control and Laboratory Records. These procedures require that all records, as either hard copy or electronic, be maintained for a period of at least ten (10) years. The records are stored in secure storage to protect them from deterioration or damage and to protect client confidentiality. In the event that the laboratory transfers ownership or goes out of business, records are maintained or transferred according to the clients' instructions. All electronic records are backed-up daily by the IT Department. Access to protected records is limited to laboratory management or their designees to prevent unauthorized access or amendment.

17.3 Legal Chain of Custody Records are managed when projects request the use of internal chain of custody procedures as described in SOP HS-SM001 Sample Log-in Procedures.

18) Audits

Quality audits are an essential part of the Quality Assurance program. Audits measure laboratory performance and verify compliance with accreditation/ certification and project requirements. Audits specifically provide management with an on-going assessment of the quality system. They are also instrumental in identifying areas where improvement in the quality system will increase the reliability of data. Audits are of four main types: internal, external, performance, and system.

18.1 Internal Audits – The laboratory periodically conducts internal audits in all areas of the laboratory to ensure that its operations continue to comply with the requirements of the Quality System as well as requirements of the standards on which the Quality System is based. The internal audit reviews laboratory conformance in two areas: quality system procedures and analytical method procedures. Analytical method evaluations include a review of how analysts perform preparation and analysis steps in conformance to approved laboratory standard operating procedures. All areas of the quality system must be conducted annually at a minimum, but any area assessments may be performed monthly or quarterly until all areas are performed. Should an area be found in nonconformance, a corrective action must be designated to the responsible individuals. Upon completion of the corrective action, re-auditing must be performed as verification.

It is the responsibility of the Quality Manager to plan and organize audits as required by the schedule and requested by management. These audits are carried out by trained and qualified personnel who are, wherever resources permit, independent of the activity to be audited. All tracking of Internal Audits is accomplished though use of Microsoft Teams. This keeps all stakeholders up-to-date on the status of Internal Audits.

Analytical method audits must be conducted in a manner such that each technology is audited at least once annually for at least one analytical method that is routinely performed and is representative of the majority of methods performed by that department. The method audited for that technology must be rotated over the course of no more than five years. After an audit is performed, a report is generated and given to management and each supervisor of the department audited. This report includes

the findings and observations and the recommendations for improvement or correction. Time-lines for responses and corrections are provided so they may be addressed in a timely fashion. The supervisors of each area provide responses to any findings with demonstration of corrections as needed.

18.1.1 An annual inspection/audit of the LIMS is performed by the quality manager or designee to ensure the quality of electronic data. Checks are done by hand calculating data, with the objective of arriving at at the same result as LIMS. This calculation report is signed and stored by the QA department. It is supplemented by a review of 10% of reports by the QA Department that verifies the existence of all required elements including a check that the data in LIMS has not changed since the report was generated.

When an audit finding casts doubt on the effectiveness of the operation or on the correctness or validity of test results, the laboratory shall notify affected clients in writing within seven days.

All investigations that result in findings of inappropriate activity are documented and include any disciplinary actions, corrective action and appropriate notifications of clients.

18.2 External Audits - It is the laboratory's policy to cooperate and assist with all external audits, whether performed by a client or an accrediting authority. All external audits are fully documented and tracked to closure. Management ensures that all areas of the laboratory are accessible to auditors as applicable and that appropriate personnel are available to assist in conducting the audit. Any findings related to an external audit follow corrective action procedures. Management ensures that corrective actions are carried out within the timeframe specified by the auditor(s).

18.3 Performance Audits - Performance audits may be Proficiency Test Samples, double-blind samples through a provider or client, or anything that tests the performance of the analyst and method.

TNI Proficiency Test (PT) samples are scheduled twice annually for each TNI field of accreditation per matrix. The PT samples tested are purchased from a TNI approved PT provider. The results assess analyst proficiency when conducting analyses for specific analyte(s) on a matrix specific basis. PT sample management, analysis and reporting of PT sample results are to be conducted in the same manner as real environmental samples utilizing the same staff and methods as used for routine analysis. This requires use of the same procedures, equipment, facilities, and frequency of analysis.

PT sample results are forwarded by QA Manager or designee to the PT provider via the provider supplied reporting format (i.e. fax, mail or internet reporting). After closing of a PT study, results are evaluated by the provider and reported directly to the primary TNI Accrediting Authority (TCEQ) and secondary TNI Accrediting Authorities when required (e.g. LDEQ), to other non-TNI State Accrediting Authorities as required, and to the laboratory. All recent results of the PT studies are posted in the laboratory and made available to the staff and interested clients. For those results that deviate from the accepted values, a nonconformance corrective action (NCAR) must be issued to the appropriate departmental supervisor or analyst to investigate and report the findings. The NCAR process typically requires analysis of another PT to verify the adequacy of the corrective action. The QA Department maintains records of the corrective action PT and related documents. The results of PT corrective actions and corrective action PT are reported to the accrediting authority as required by the respective program. Corrective

PT studies are sent directly to all respective accrediting authorities

18.4 System Audits

A quality system audit reviews general laboratory cleanliness, employee training documentation, support systems, equipment and facilities maintenance and repair records, sample handling and record-keeping practices. Various checklists may be used including, but not exclusively, the Combined ISO/IEC 17025:2017, NELAC TNI 2016 Module 2 and DoD QSM Version 5.4 Quality System Requirements from A2LA, the TNI 2009 and DoD/DOE QSM Version 5.4 Checklist from PJLA, the TNI 2016 Standard Checklist from The NELAC Institute, or one developed by ALS Environmental. Quality (or Management) System Audits are conducted annually, usually in the first quarter of the new year. The Laboratory's management system is also audited though annual management reviews. Refer to Sections 19 – "Management Review" and SOP CE-QA001 Internal Audits for further discussion of systems audits.

18.5 Handling Audit Findings

Internal or external audit findings are responded to within the time frame agreed to at the time of the audit. The response may include action plans that could not be completed within the response time frame. A completion date is established by management for each action item and included in the response.

The responsibility for developing and implementing corrective actions to findings is the responsibility of the Quality Assurance Manager or the Technical Director. Corrective actions are documented through the corrective action process described in Section 16 – "Corrective Actions".

Audit findings that cast doubt on the effectiveness of the laboratory operation to produce data of known and documented quality or that question the correctness or validity of sample results must be investigated. Corrective action procedures described in SOP HS-QS003: "Nonconformance and Corrective Action Procedure" must be followed. Clients must be notified in writing if the investigation shows the laboratory results have been negatively affected and the client's requirements have not been met. The client must be notified within one business day after the laboratory discovers the issue. Laboratory management will ensure that this notification is carried out within the specified time frame.

All investigations that result in findings of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients

19) Management Review

19.1 Top management reviews the management system on an annual basis and maintains records of review findings and actions. The review ensures that the quality system of the laboratory continues to conform to the requirements of the ISO 17025:2017 and various accrediting authorities, including NELAP/TNI and the current DoD QSM.

19.2 Management Review Topics

The following are reviewed to ensure their suitability, adequacy, and effectiveness:

- Changes in internal and external issues that are relevant to the laboratory
- Fulfilment of objectives
- The suitability of policies and procedures;
- Status of actions from previous management reviews
- Reports from managerial and supervisory personnel;
- The outcome of recent internal audits;
- Corrective and preventive actions;
- Assessments by external bodies;
- The results of inter laboratory comparisons or proficiency tests;
- Changes in the volume and type of the work;
- Customer and personnel feedback;
- Complaints;
- Recommendations for improvement;
- Effectiveness of any implemented improvements
- Results of risk and opportunity identification
- Outcomes of the assurance of the validity of results
- Other relevant factors, such as quality control activities, resources, and staff training.

19.3 The procedure for Management Review can be found in SOP HS-QS017. Findings and follow-up actions from management reviews are recorded. Those outputs will examine the effectiveness of the management system and its processes, improvement of the laboratory activities, provision of required resources, and any need for change. Management will determine appropriate completion dates for action items and ensure they are completed within the agreed upon time frame.

20) Personnel

ALS employs competent personnel based on education, training, experience and demonstrated skills as required. The laboratory's organization chart can be found in Appendix B.

20.1 Overview

20.1.1 Training begins on the first day of employment at the laboratory when the company policies are presented and discussed. Safety and Quality System requirements are integral parts of initial and ongoing training processes at the laboratory. Safety training begins with the reading of the ALS Environmental Health and Safety Manual. Employees are also required to attend periodic safety meeting where additional safety training may be performed by the Environmental, Health, and Safety Officer.

20.1.2 Quality Systems training begins with QA orientation for new employees, which includes ethics/data integrity introductory training, and reading the QA Manual. During the employee's first year, the employee attends additional core ethics training and further learns about the laboratory quality systems as they relate to

specific job functions. Each employee participates in annual ethics refresher training.

20.1.3 All personnel are responsible for complying with all quality and data integrity policies and procedures that are relevant to their area of responsibility.

20.1.4 All personnel who are involved in activities related to sample analysis, evaluation of results or who sign test reports, must demonstrate competence in their area of responsibility. Appropriate supervision is given to any personnel in training and the trainer is accountable for the quality of the trainees work. Personnel are qualified to perform the tasks they are responsible for based on education, training, technical knowledge, experience and demonstrated skills as required for their area of responsibility.

20.1.5 The laboratory provides goals with respect to education, training and skills of laboratory staff. Training needs are identified at the time of employment and when personnel are moved to a new position or new responsibilities are added to their job responsibilities. Ongoing training, as needed, is also provided to personnel in their current jobs. The effectiveness of the training must be evaluated before the training is considered complete.

20.1.6 An overview of top management's responsibilities are included in Section 3 – "Management". Job descriptions include the specific tasks, minimum education and qualifications, skills, and experience required for each position. Job description for staff not in management can be found in their individual personnel folder.

20.2 Training

20.2.1 SOP-HS-QS013 Employee Training requires all analysts to be trained in the elements of this QA Manual, and that they must sign a method qualification statement that they have read, understand and agree to follow the technical SOPs they perform.. This information must be on file in the QA department after completion and it the responsibility of each departmental supervisor that these items are completed and approved before any work is commenced.

20.2.2 All personnel are appropriately trained and competent in their assigned tasks before they can contribute to functions that can affect data quality. It is management's responsibility to assure personnel are trained. Training records are used to document management's approval of personnel competency. The date on which authorization and/or competence is confirmed is included.

Training records are maintained by the Quality Assurance Manager and include Demonstrations of Capability (Initial and Continuing), Experience Documentation, and Ongoing Training.

Staff members are given the following ongoing training:

20.2.2.1 All staff members are given refresher data integrity training as outline in §20.3.1. This training is documented by the ALS Human Resources Department.

20.2.2.2 The employee attests, through signature, that they have read, understood, and agree to perform the latest version of the Quality Manual and any SOPs or policies that the analyst is responsible for following.

20.2.2.3 Annually, the analyst shows continued proficiency in each method they perform by Continuing Demonstration of Capability or by passing a Performance Evaluation Sample, see § 12.2

20.3 Ethics and Data Integrity Training

20.3.1 Employees are required to understand that any infractions of the laboratory data integrity procedures shall result in a detailed investigation that could lead to very serious consequences including immediate termination, debarment or civil/criminal prosecution. This is discussed in the Ethics and Data Integrity Policy that every employee is required to to review upon onboarding and every January after that. No employee is allowed to conduct tests in the lab (including the iDOC described in §12.1) until they have completed this Ethics and Data Integrity Training. The following topics are covered:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting
- How and when to report data integrity issues
- Record keeping
- Training, including discussion regarding all data integrity procedures
- Data integrity training documentation
- In-depth data monitoring and data integrity procedure documentation
- Specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards.

20.3.2 SOP CE-GEN001 Laboratory Ethics and Data Integrity Procedures- provides guidance and direction for employees when generating laboratory data and a thorough understanding of what constitutes an improper, unethical or illegal action and consequences of such action. The ethics policy specifically defines employee responsibility and accountability with the following being required of all personnel:

20.3.2.1 ALS Group USA, Corp employees shall at all times conduct themselves and the business of the Company in an honest and ethical manner.

20.3.2.2 ALS Group USA, Corp employees shall comply with the terms of the ethics policy, and as a condition of employment is required to sign the Ethics Training confirmation.

20.3.2.3 The willful act of improper manipulation or falsification of data will not be tolerated and is subject to punitive measures up to and including dismissal and subsequent legal action.

20.3.2.4 Observance of unethical behavior shall be immediately reported to a supervisor, a manager, or the QA Manager. Failure to report such activity is considered to be in support of the unethical activity and shall be dealt with in those terms.

20.3.2.5 Unauthorized release of confidential information about the Company or its customers shall be subject to disciplinary action, up to and including dismissal and subsequent legal action.

20.3.3 Employees are trained to understand that improper or unethical actions are serious matters that can have a very negative effect on the laboratory. The actions can result in any of the following: potential civil or criminal liability for ALS Group USA, Corp and employees; cost in time and resources of defending data before auditors; loss of client trust; loss of business and potential fines and imprisonment of employees involved. In order to maintain the integrity and reputation of ALS Group USA, Corp, it is most important that all the data released in projects be as factual as possible. Therefore, misrepresentation of any data by an ALS Group USA, Corp employee is not allowed. Any employee who knowingly releases false data values will be subject to disciplinary action, up to an including possible termination of employment and legal action.

20.3.4 Periodic monitoring of data integrity is performed by the QA department when performing laboratory data audits as part of SOP HS-QS012 Internal Audits or at any time by the QA Department should an inappropriate action be suspected or a lack of proper training be evident. In addition to periodic monitoring QA will on a periodic based perform an in-depth monitoring following the procedure in the process that includes items such as preparation, equipment, software, calculations and quality control.

20.3.5 Documented data integrity procedures are part of training provided in SOP HS-QS016 Manual Integration Policy and SOP HS-QS009 Data Reduction, Review and Validation.

21) Reporting of Results

The laboratory reports the analytical data produced in its laboratories to the client via the Analytical Report. This report includes a transmittal letter, a case narrative, client project information, sample receipt and chain of custody information, specific test results, quality control data (as requested), and any other project-specific support documentation.

The results shall be provided accurately, clearly, unambiguously and objectively, usually in a report, and shall include all the information agreed with the customer and necessary for the interpretation of the results and all information required by the method used. All issued reports shall be retained as technical records.

The following procedures describe the procedures used for data reduction, validation and reporting.

21.1 Data Reduction and Review

Results are generated by the analyst who performs the analysis and works up the raw data. All data is initially reviewed and processed by analysts using appropriate methods (e.g., chromatographic software, instrument printouts, hand calculation, etc.). Equations used for calculation of results are found in the applicable analytical SOPs. Policies and procedures for manual editing of data are established. The analyst making the change must initial and date the edited data entry, without obliteration of the original entry. The policies and procedures are described in the SOP CE-QA007, *Making Entries onto Analytical Records*.

The resulting data set is either manually entered (e.g., titrimetric or spectrophotometer data) into an electronic report form or is electronically transferred into the report. Once the complete data set has been transferred into the proper electronic report form(s), it is then printed. The resulting hardcopy version of the electronic report is then reviewed by the analyst for accuracy. Once the primary analyst has checked the data for accuracy and acceptability, the data and report hardcopy is forwarded to the supervisor or second qualified analyst who reviews the data. Where calculations are not performed using a validated software system, the reviewer rechecks a minimum of 10% of the calculations. Analysts performing routine testing are responsible for generating a data quality narrative or data review document with every analytical batch processed. This report also allows the analyst to provide appropriate notes and/or a narrative if problems were encountered with the analyses. A Nonconformance and Corrective Action Report (NCAR) may also be attached to the data prior to review. Supervisors or qualified analysts review all of the completed analytical batches to ensure that all QC criteria have been examined and any deficiencies noted and addressed. Data review procedures are described in SOP *HRMS Data Review and Processing* (HE-HMS003) or *Data Reduction, Review, and Validation* (HS-QS009).

Policies and procedures for electronic manual integration of chromatographic data are established. The analyst performing the integration must document the integration change by printing both the “before” and “after” integrations and including them in the raw data records. The policies and procedures are described in SOP HS-QS016, *Manual Integration Policy*.

The QA Manager or designee must review 10% of all DoD final reports issued by the laboratory on a quarterly basis. The reviewer must also review laboratory data package for technical completeness and accuracy on a quarterly basis to evaluate correctness of all action taken during the course of sample analysis. Errors discovered in this stage of review require the issuance of a nonconformance and corrective action report (NCAR). Report revisions recommended as part of a corrective action investigation will be coordinated with the Project Manager. Client must be notified within 15 days if data quality issues are discovered.

The results shall be reviewed and authorized prior to release. Any error discovered in this stage of review will require the issuance of a correction action. Report revision recommended as part of the corrective action will be coordinated with the Project Manager.

21.2 Validation of Results

The validity of the data generated is assessed through the evaluation of the sample results, calibrations, and QC samples (method blanks, laboratory control samples, sample duplicates, matrix spikes, trip blanks, etc.). A brief description of the evaluation of these analyses is described below, with details listed in applicable SOPs. The criteria for evaluation of QC samples are listed within each method-specific SOP. Other data evaluation measures can include verifications of accuracy, QC samples, and system sensitivity check of the QC standards and a check of the system sensitivity. Data transcriptions and calculations are also reviewed.

Note: Within the scope of this document, all possible data assessment requirements for various project protocols cannot be included in the listing below. This listing gives a general description of data evaluation practices used in the laboratory in compliance with TNI Quality Systems requirements. Additional requirements exist for certain programs, such as projects under the DoD QSM protocols, and project-specific QAPPs.

- Initial Calibration – Following the analysis of calibration standards according to the applicable SOP the data is fit to an applicable and allowed calibration model (correlation coefficient, linear, average response factor, quadratic, etc.) and the resulting calibration is compared to specified criteria. If the calibration meets criteria analysis may continue. If the calibration fails, any problems are isolated and corrected and the calibration standards reanalyzed. Following calibration and analysis of the independent calibration verification standard(s) the percent difference for the ICV is calculated. If the percent difference is within the specified limits the calibration is complete. If not, the problem associated with the calibration and/or ICV are isolated and corrected and verification and/or calibration is repeated.
- Continuing Calibration Verification (CCV) – Following the analysis of the CCV standard the percent difference is calculated and compared to specified criteria. If the CCV meets the criteria analysis may continue. If the CCV fails, routine corrective action is performed and documented and a 2nd CCV is analyzed. If this CCV meets criteria, analysis may continue, including any reanalysis of samples that were associated with a failing CCV. If the routine corrective action failed to produce an immediate CCV within criteria, then either acceptable performance is demonstrated (after additional corrective action) with two consecutive calibration verifications or a new initial calibration is performed.

- Method Blank – Results for the method blank are calculated as performed for samples. If results are less than the MRL (<½ MRL for DoD projects), the blank may be reported. If not, associated sample results are evaluated to determine the impact of the blank result. If possible, the source of the contamination is determined. If the contamination has affected sample results the blank and samples are reanalyzed. If positive blank results are reported, the blank (and sample) results are flagged with an appropriate flag, qualifier, or footnote.
- Sample Results (Inorganic) – Following sample analysis and calculations (including any dilutions made due to the sample matrix) the result is verified to fall within the calibration range. If not, the sample is diluted and analyzed to bring the result into calibration range. When sample and sample duplicates are analyzed for precision, the calculated RPD is compared to the specified limits. The sample and duplicate are reanalyzed if the criteria are exceeded. The samples may require re-preparation and reanalysis. For metals, additional measures as described in the applicable SOP may be taken to further evaluate results (dilution tests and/or post-digestion spikes). Results are reported when within the calibration range, or as estimates when outside the calibration range. When dilutions are performed the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRL's including alternative analysis.
- Sample Results (Organic) – For GC/MS analyses, it is verified that the analysis was within the prescribed tune window. If not, the sample is reanalyzed. Following sample analysis and calculations (including any dilutions made due to the sample matrix) peak integrations, retention times, and spectra are evaluated to confirm qualitative identification. Internal standard responses and surrogate recoveries are evaluated against specified criteria. If internal standard response does not meet criteria, the sample is diluted and reanalyzed. Results outside of the calibration range are diluted to within the calibration range. For GC and HPLC tests, results from confirmation analysis are evaluated to confirm positive results and to determine the reported value. If obvious matrix interferences are present, additional cleanup of the sample using appropriate procedures may be necessary and the sample is reanalyzed. When dilutions are performed the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRL's including additional cleanup.
- Surrogate Results (Organic) – The percent recovery of each surrogate is compared to specified control limits. If recoveries are acceptable, the results are reported. If recoveries do not fall within control limits, the sample matrix is evaluated. When matrix interferences are present or documented, the results are reported with a qualifier that matrix interferences are present. If no matrix interferences are present and there is no cause for the outlier, the sample is re-prepared and reanalyzed. However, if the recovery is above the upper control limit with non-detected target analytes, the sample may be reported. All surrogate recovery outliers are appropriately qualified on the report.
- Duplicate Sample and/or Duplicate Matrix Spike Results – The RPD is calculated and compared to the specified control limits. If the RPD is within the control limits the result is reported. If not, an evaluation of the sample is made to verify that a homogenous sample was used. Despite the use of homogenizing procedures prior to sample preparation or analysis, the sample may not be homogenous or duplicate sample containers may not have been sample

consistently. If non-homogenous, the result is reported with a qualifier about the homogeneity of the sample. Also, the results are compared to the MRL. If the results are less than five times the MRL, the results are reported with a qualifier that the high RPD is due to the results being near the MRL. If the sample is homogenous and results above five times the MRL, the samples and duplicates are reanalyzed. If re-analysis also produces out-of-control results, the results are reported with an appropriate qualifier.

- Laboratory Control Sample Results – The LCS percent recovery is calculated and compared to specified control limits. If the recovery is within control limits, the analysis is in control and results may be reported. If not, this indicates that the analysis is not in control. Samples associated with the 'out of control' LCS, shall be considered suspect and the samples re-extracted or re-analyzed or the data reported with the appropriate qualifiers. For analysis where a large number of analytes are in the LCS, it becomes more likely that some analytes (marginal exceedences) will be outside the control limits.
- Matrix Spike Results – The MS percent recovery is calculated and compared to specified control limits. If the recovery is within control limits the results are reported. If not, and the LCS is within control limits, this indicates that the matrix potentially biases analyte recovery. It is verified that the spike level is at least five times the background level. If not, the results are reported with a qualifier that the background level is too high for accurate recovery determination. If matrix interferences are present or results indicate a potential problem with sample preparation, steps may be taken to improve results; such as performing any additional cleanups, dilution and reanalysis, or re-preparation and reanalysis. Results that do not meet acceptance limits are reported with an appropriate qualifier.

21.3 Qualitative Data Evaluation

All sample results and QC results are reviewed to ensure correct identification of target analytes, when not inherent to the test method. Details particular to each analysis are given in the analytical SOP.

Identification criteria for GC, LC or GC/MS methods are summarized below:

- GC and LC Methods
  - The analyte must fall within the retention time window specified in the applicable SOP. The retention time window is established prior to analysis and documented.
  - For analyses all positive results are confirmed by a second column, a second detector, a second wavelength (HPLC/UV), or by GC/MS analysis. Confirmation data will be provided as specified in the method.
  - When sample results are confirmed by two dissimilar columns or detectors, the agreement between quantitative results must be evaluated. The relative percent difference between the two results is calculated and evaluated against SOP and/or method criteria.
- GC/MS and LC/MS Methods – Two criteria are used to verify identification:
  - Elution of the analyte is at the same relative retention time (as defined by the method) as demonstrated in the standard.

- The mass spectrum of the analyte in the sample must, in the opinion of a qualified analyst or the department manager, correspond to the spectrum of the analyte in the standard or the current GC/MS reference library.
- When Tentatively Identified Compounds are to be reported for GC/MS, the spectrum for non-target peaks is compared to the current GC/MS reference library.

21.4 Data Reporting

It is the responsibility of each laboratory unit to provide the Project Manager with a final report of the data for each analysis, accompanied by signature approval. When the entire data set has been found to be acceptable, a final copy of the report is generated and approved by the laboratory supervisor, departmental manager or designated laboratory staff. ALS Environmental- Houston has procedures in place to guard against improper use of the electronic signature and have the required "signatories", signing the reports. The entire data package for the analysis is then placed into the service request file, and an electronic copy of the final data package is forwarded to the appropriate personnel for archival. Footnotes and/or narrative notes must accompany any data package if problems were encountered that require further explanation to the client. Each data package is submitted to the appropriate Project Manager.

When all analyses and departmental reports are completed the Project Manager reviews the entire collection of analytical data for completeness and to ensure that any and all client-specified objectives were successfully achieved. A report narrative is written by the Project Manager to explain any unusual problems with a specific analysis or sample, etc. Prior to release of the report to the client, the Project Manager reviews and approves the entire report for completeness and to ensure that any and all client-specified objectives were successfully achieved. The original raw data, along with a copy of the final report, is scanned and archived by service request number.

The laboratory reports results based on the sample provided by the customer. If ALS reports to a specification it is only for the sample results and not involved with decision rules applied to the sampling site.

To the extent possible, samples shall be reported only if all QC measures are acceptable. If a QC measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). The SOPs *HRMS Data Review and Reporting* (HE-HMS003) and *Data Reduction, Review, and Validation* (HS-QS009) address the flagging and qualification of data. The ALS-defined data qualifiers, state-specific data qualifiers, or project-defined data qualifiers are used depending on project requirements. A case narrative may be written by the Project Manager to explain problems with a specific analysis or sample, etc.

If opinions and interpretations are expressed, either verbally or in reports, based on the results obtained from the tested items, the laboratory will ensure that only personnel authorized for the expression of opinions and interpretations release the respective statement. The laboratory will also document the basis upon which the opinions and interpretations have been made and also retain record of such dialogue to the client. ALS at this time however, does not make any statements concerning opinions and interpretation of results.

When requested by the client or relevant to the validity of reported results, the estimation of measurement uncertainty will be provided to a client or regulatory agency. How the uncertainty will be reported may be dictated by the client's reporting specifications. Where applicable, the measurement of uncertainty should be presented in the same unit as that of the measure or in a term relative to the measure, when: it is relevant to the validity of the test result, a customer requires or if the measurement uncertainty affects conformity to a specification limit. Additional information that may be required by specific methods, authorities, customers or groups of customers should also be put in the report if it enhances interpretation of results. Where necessary for better interpretation of test results the report will also include Procedures for determining and reporting uncertainty are given in SOP CE-QA010, *Estimation of Uncertainty of Analytical Measurements*.

When an issued report needs to be changed, amended or re-issued, any change of information shall be clearly identified and, where appropriate, the reason for the change included in the report.

For subcontracted analyses, the Project Manager verifies that the report received from the subcontractor is complete. This includes checking that the correct analyses were performed for each sample as requested, a report with clear identification that results are from an external provider is sent to the client.

21.5 Deliverables

In order to meet individual project needs, the laboratory provides several levels of analytical reports. Standard specifications for each level of deliverable are described in Table 21-1. Variations may be provided based on client or project specifications. This includes (but is not limited to) deliverables for DoD QSM projects and state-specific drinking water formats.

Each report sent out to the clients shall include at least: the name and contact information of the customer and a statement indicating that the results relate only to the items tested. The laboratory is responsible for all the information provided in the report, except for information provided by the customer. Data provided by a customer shall be clearly identified. In addition, a disclaimer shall be put on the report when the information is supplied by the customer and can affect the validity of the results. It shall state in the report that the results provided apply to the sample as received.

When requested, the laboratory provides Electronic Data Deliverables (EDDs) in the format specified by client need or project specification. The laboratory is capable of generating EDDs with many different formats and specifications. The EDD is prepared by report production staff using the electronic version of the laboratory report to minimize transcription errors. User guides and EDD specification outlines are used in preparing the EDD. The EDD is reviewed and compared to the hard-copy report for accuracy.

Table 21-1

Descriptions of ALS Environmental – Houston Standard Data Deliverables*
Tier I. Routine Analytical Report includes the following:
• Transmittal letter
• Chain of custody documents and sample/cooler receipt documentation
• Sample analytical results
• Method blank results
• Surrogate recovery results and acceptance criteria for applicable organic
• Dates of sample preparation and analysis for all tests
• Case narrative – optional
Tier II. In addition to the Tier I Deliverables, this Analytical Report includes the following:
• Laboratory Control Sample results with calculated recovery and associated acceptance criteria
• Matrix spike results with calculated recovery and associated acceptance criteria
• Duplicate or duplicate matrix spike result(s) (as appropriate to method), with calculated relative percent difference
• Case narrative – optional
Tier III. Data Validation Package. In addition to the Tier II Deliverables, this CAR includes the following:
• Case narrative - required
• Summary forms for all associated QC and Calibration parameters, with associated control criteria/acceptance limits
• Other summary forms specified in QAPPs or project/program protocols, or those related to specialized analyses such as HRGC/MS are included.
Tier IV. Full Data Validation Package.
• All raw data associated with the sample analysis, including but not limited to: • Preparation and analysis bench sheets and instrument printouts, • For organics analyses, all applicable chromatograms, spectral, confirmation, and manual integration raw data. For GC/MS this includes tuning results, mass spectra of all positive results, and the results and spectra of TIC compounds when requested.
• QC data
• Calibration data (initial, verification, continuing, etc.),
• Calibration blanks or instrument blanks (as appropriate to method).

* If a project QAPP or program reporting protocol applies the report will be presented as required for the project.

21.6 A statement of compliance/non-compliance when requirements of the quality systems are not met, including identification of test results that do not meet TNI sample acceptance requirements, such as holding time, preservation, etc., are included in the project narrative;

21.6.1 When requested by the client, a statement on the estimated uncertainty of the measurement is included in the project narrative as per ALS SOP HS-QS024 "Trending, Control Limits, and Uncertainty" .

21.7 Electronic Transmission of Results

All test results transmitted by telephone, fax, telex, e-mail, or other electronic means comply with the requirements of the TNI Standard and associated procedures to protect the confidentiality and proprietary rights of the client. Electronic Data Deliverables are provided to the client as needed and as defined by the client.

21.8 Advertising Policy

21.8.1 ALS's TNI accredited laboratories can use the TNI accredited logo by adherence to the following:

21.8.1.1 Where the TNI name and/or logo is used on general literature such as letterhead and advertisement, it shall always be accompanied by the word "accredited".

21.8.1.2 While there are no restrictions on the size and color of the TNI accredited logo reproduction, the logo must maintain its form.

21.8.1.3 The TNI accredited logo may be generated electronically provided that the prescribed formats and forms are retained.

21.8.1.4 When promoting or providing proof of accreditation, accredited laboratories should use the scope(s) of accreditation, as this document details the specific tests which are accredited. The certificate should be used for display purposes and may also accompany the scope.

21.8.1.5 When the TNI accredited logo is used to endorse test results, it shall always be accompanied by the TNI accreditation number(s).

21.8.1.6 When the TNI accredited logo is used on a business solicitation document such as a proposal or quotation form, the laboratory has the responsibility to distinguish between those proposed tests that fall within the laboratory's scope of accreditation and those that do not. This is done by attaching a copy of the current TNI Scope of Accreditation sheet and Supplement to the Scope, if appropriate, or by noting which tests or calibration is non-accredited.

21.8.1.7 The TNI accredited logo and/or reference to the laboratory's accreditation may be made in advertisements provided the requirements of this document are strictly followed.

21.8.1.8 Upon suspension or termination of accreditation, a laboratory must immediately cease to issue test reports displaying the logo and shall cease publishing documents containing the logo.

21.8.2 ALS's PJLA accredited laboratories can use the PJLA accredited logo by

adherence to the following:

21.8.2.1 ALS must fully comply with the most current revision of PJLA SOP-3 Accreditation Symbol Procedure.

21.8.2.2 Upon suspension or termination of accreditation, a laboratory must immediately cease to issue test reports displaying the logo and shall cease publishing documents containing the logo.

22) Continuous Improvements

22.1 ALS Environmental routinely engages in quality improvement through ongoing use of internal systems and evaluation of external feedback. Senior management supports this policy by making continuous improvement one of the ALS Core Values, see SOP CE-GEN 016 Continuous Quality Improvement Policy.

22.1.1 Management Role

ALS management is committed to improvement of the management and quality systems through compliance with its own policies and procedures; and evolving these policies and procedures as needed.

Senior management, Laboratory Directors, and laboratory management teams support improvement activities and processes. Improvement is effected through ongoing management review and evaluation of improvement opportunities and using available input.

22.1.2 Quality System Role

Quality systems are designed to meet the requirements of various certification and accreditation protocols and standards, as well as various program and project requirements. As these requirements change or new ones become applicable, ALS will pursue improvements to the quality systems and protocols as warranted.

As part of the quality system several procedures and policies are in place which include a component of improvement. Quality programs at ALS laboratories will ensure that these procedures and policies are implemented.

22.2 Improvement in the overall effectiveness of the laboratory management system is a result of the implementation of the various aspects of the laboratory's management system: quality policy and objectives (QAM Section 3 – "Management"); internal auditing practices (SOP HS-QS012 Internal Audits); the review and analysis of data (SOP HS-QS009 Data Reduction, Review and Validation); corrective action (SOP HS-QS003 Nonconformance / Corrective Action Reporting) and preventive action (QAM Section 16 – "Preventative Action") process; and the annual management review of the quality management system (SOP HS-QS017 Management Review) where the various aspects of the management/quality systems are summarized, and evaluated and plans for improvement are developed.

23) Management of Change

23.1 This procedure is to be utilized by ALS-Environmental USA laboratories where required by certification or accreditation, project specifications, or contract to make changes in a planned or systematic way, to reduce negative impacts upon the organization, staff, and clients. See SOP CE-GEN015 Management of Change for policy and produces. Tracking of change is accomplished though use of Microsoft Teams. This keeps all stakeholders up-to-date on the status of changes.

23.1.1 Changes to be managed may lie within the organization and controlled by the organization; or may be internal changes that have been triggered by external events originating outside the organization, over which we have little or no control (e.g. regulatory changes, actions of competitors, or technological changes).

23.1.2 The scale and potential impact of the proposed change will indicate whether or not the use of this procedure is required. For example, purchase and introduction of a new pH meter would have little impact on the laboratory; whereas purchase and introduction of instrumentation not previously used could have a major impact on the laboratory (i.e. training required, allocation of laboratory space, changes to sample preparation and work procedures etc.) and therefore would require implementation of this procedure.

23.2 Actions to Address Risks and Opportunities

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

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

Risk is defined at ALS Environmental - Houston as the effect of uncertainty on objectives. Objectives for the organization have different attributes and aspects, such as financial, service, quality, health & safety, environmental

stewardship, and are considered at different levels, such as enterprise-wide, operational, and project levels. ALS Environmental - Houston interprets risk as anything that could impact meeting its corporate strategic objectives and believes risks can provide positive opportunities as well as having negative impacts.

Tools for evaluating and managing risk include routine procedures such as employee evaluations, control limits trending, RLVS data evaluation, corrective action reports, nonconforming events, SOP review, internal and external audits, and PT results.

Risk reporting mechanisms vary from routine reporting mechanisms and immediate action for lower risk situations to immediate notification of the ALS Environmental - Houston CEO in extreme cases.

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

Risk severity is evaluated during the decision-making process. For each risk there is an opportunity.

23.2.2 Risks to our business and how we address them include:

23.2.2.1 **Chemical Exposure**

Failure to practice procedures as trained, issues with the facility, and poor engineering controls can result in injury to employees, lost time, med/hospital situation, contamination, and can close the site.

We have policies, chemical exposure training, and readily available SDS sheets. Employees are expected to offer suggestions for improvement and formally report any conditions where concern for safety is recognized.

23.2.2.2 **Explosion/Chemical Fire**

Improper chemical storage and usage along with lack of equipment and facility upkeep can result in loss of life, loss of property, and laboratory down time.

We perform inspections and training, keep an inventory of chemicals, establish storage locations, and maintain minimal quantities of chemicals.

23.2.2.3 **Supply Disruption**

Natural disaster and vendors unable to provide needed supplies can disrupt the business, increase expenses, and result in lost production and lost clients.

We maintain multiple sources for supplies, develop relationships with our vendors, and emphasize communication between analysts, managers, purchasing and vendors.

23.2.2.4 **Loss of Key Employees**

Resignation, leave for personal reasons or for other employment can negatively impact the business.

Communication, cross-training, designated backups, and having a pool of potential replacements minimizes this risk. We provide a positive atmosphere for employees and provide small perks to reward dedication.

23.2.2.5 **Computer and Instrument Issues**

Computer, instrument, or other IT failures can result in loss of revenue, loss of service, and loss of data.

We provide necessary IT resources for instruments and computers including replacing older computers, keeping related systems in good repair, and replacing when necessary. We continue to build robust data systems and make provisions for stellar back-up storage for all data.

23.2.2.6 **Reputation**

Falsifying test results can result in loss of credibility, loss of clients, loss of revenue, and suspension.

All new employees must have initial ethics and data integrity training and sign an acknowledgement to that effect. Annually, all employees must take ethics and data integrity refresher training. All data undergoes a proper peer review. We maintain a strong quality system.

23.2.2.7 **Legal Ramifications**

Not following workplace and environmental laws and failure to practice procedures as trained can result in license revocation, fines, and disruption of the business.

Targeted and ongoing training, inspections, and having established procedures minimizes this risk. We continue to follow all laws and regulations.

23.2.2.8 **Loss Time Injury**

Failure to practice procedures as trained and not having proper safeguards in place can result in injury to employees, lost time, med/hospital situation, contamination, and can close the site.

Policies, specific task related training, targeted and ongoing training, inspections, workplace safeguards, cross training, and designated backups, minimize this risk. We continue to grow the safety program and culture.

23.2.2.9 **Loss of Revenue**

Can be caused by various audit fines and contract penalties for late data resulting in loss of revenue and disruption in business.

Policies, specific quality training, targeted and ongoing training, inspections, workplace safeguards, and internal audits minimize this risk. We continue to perform lab operations at the highest level.

24) Summary of Changes and Document History

Revision Number	Effective Date	Document Editor	Description of Changes
12.0	03/31/2022	M.B. Johnston	Eliminated Appendices C (Ethics & Data Integrity Agreement), E (Equipment List), G (SOPs list), I (External Documents list). Replaced with a reference to their location in the Quality System.
12.0	03/31/2022	M.B. Johnston	§23.2: Add Risk & Opportunities section
12.0	03/31/2022	M.B. Johnston	Combine ALSHS (Full Service Lab) QAM and ALSHE (HRMS/Specialties Lab) QAM
11.6	09/11/2020	E. Marinez	Update subsections for 21.5 Advertizing Policy to remove references to L-A-B and replace with proper references to PJLA.
11.6	09/11/2020	E. Marinez	Appendix J Laboratory Accreditations and Scopes Update Certificate numbers, where applicable. Remove ANAB certificate and scope. Replace with PJLA certificate and scope.
11.6	9/11/2020	E. Marinez	Section 25 References Update references to current versions where applicable. Remove any references to ANAB. Insert references to PJLA.
11.6	9/11/2020	E. Marinez	Appendices updated to most current lists and information, where applicable.
11.5	12/21/2019	G. Moulton	Sec 8.1: The laboratory collaborates with clients and/or their representatives in clarifying their requests and in monitoring of the laboratory performance related to their work. Each request is reviewed to determine the nature of the request and the laboratory's ability to comply with the request within the confines of prevailing statutes and/or regulations without risk to the confidentiality of other clients.
11.5	12/21/2019	G. Moulton	Sec 8.1.1: The laboratory actively seeks client feedback, both positive and negative, to identify areas of improvement within the quality system, testing activities and service to the client.
11.5	12/21/2019	G. Moulton	Sec 8.1.2: The laboratory will clarify requests if the customer has specified incorrect, obsolete, or improper methods.
11.5	12/21/2019	G. Moulton	Sec 8.1.3: The laboratory will notify customers when methods require modifications to ensure achievement of project-specific objectives contained in planning documents (e.g., difficult matrix, poor performing analyte).
11.5	12/21/2019	G. Moulton	Sec 8.1.4: The laboratory will communicate with customers when project planning documents (e.g., QAPP or Sampling and Analysis Plan (SAP)) are missing or

Revision Number	Effective Date	Document Editor	Description of Changes
			requirements (e.g., action levels, detection and quantification capabilities) in the documents require clarification.
11.5	12/21/2019	G. Moulton	Sec 8.1.5: The laboratory will notify customers when a problem has been encountered with sampling or analysis that may impact results (e.g., improper preservation of sample).
11.5	12/21/2019	G. Moulton	Sec 19.1 Updated elements of a management review added new elements from ISO 17025.
11.4	12/21/2018	G. Moulton	Updated cover and quality manager
11.4	12/21/2018	G. Moulton	Split QAM into two sections to allow for the Appendices to be upldated regularly without affecting the body of the QAM.
11.4	12/21/2018	G. Moulton	Revised numbering for sections 1.3.1 to 1.3.3, 2.1.1 to 2.1.3, 3.1.1 to 3.1.11.6, 3.5.2.1 to 3.5.2.5, 3.5.3.1 to 3.5.5.1, 3.7.1 to 4.2, 4.7.1 to 4.7.2, 5.1 to 10.4, 11.2.2.1 to 11.2.2.12.1, 11.2.4.2 to 11.4.1 , 12.3.3.1TO 12.3.3.4, 12.5.4.1 to 12.5.4.3, 12.8.1.1 to 12.8.2.6, 12.8.3.1 to 12.8.3.1.2. 13.1.9.1 to 13.1.9.3, 14.1.8.1 to 14.4.1.6, 16.1 to 16.1.2, 16.2 to 16.2.3, 17.1.1 to 17.1.29, 18.5.1 to 18.5.4, 20.1.1 to 20.1.4, 20.2.2.1 to 20.2.2.3, 20.3.2.1 to 20.3.2.6, 21.1.1.1 to 21.1.1.11, 25.1 to 25.1.22.
11.4	12/21/2018	G. Moulton	Appendices: Removed resumes, Updated Org chart, Added signatories for reports, Updated External documents list, Updated SOP list, Added certs with expiration dates. 18.1.2 Added LIMS inspection.
11.4	12/21/2018	G. Moulton	Modified sec. 2.2 (added responsible individual Hoai Van). 2.4: agreements and impartiality. sec: 3.2.7 (sample management Supervisor). Modified 3.4 Quality policy. 3.5.4.5, modified 3.7.(elements of a SOP). Modified sec 4.5, and 4.6.1 update and location of controlled doc.Modified sec 5.3 add SOP HS-GEN009 and current version of DOD QSM, Modified sec 9.2, 9.3 and 9.4 To improve complaint resolution. Modified 10.5: added sec 10.5, sec 11.1 (coc for evidentiary purpose), Inserted SOP HS-HS019, 12.5.2 (Inserted sop HS-QS009). 12.5.4 (Inserted sop HS-IT007), Modified 12.6.6 IT Secutity. Modified sec 13.1.9.1

Revision Number	Effective Date	Document Editor	Description of Changes
			(bracketing range of use, weights certified every year). Sec 20.1.4: included where staff job descriptions can be found.
11.4	12/21/2018	G. Moulton	Reworded sec 10.3 (power loss), reworded last line of sec 12.2 (IDOC requirement). 12.3.1 and 12.3.2 (LODs/LOQ analyzed on a quarterly basis)
11.4	12/21/2018	G. Moulton	Added sec 8.2.6 and 8.2.7 – Client confidentiality.
11.4	12/21/2018	G. Moulton	Removed last two sentences of 10.4
11.4	12/31/17	T. Yen	3.5.4 - 3.5.5 Ethics and Data Integrity Investigation and Notification.
11.3	06/19/2017	T. Yen	General review.
11.3 – Section 4.4.3	06/19/2017	T. Yen	Preparation and Management of SOP
11.3 – Section 6	06/19/2017	T. Yen	Subcontracted testing procedure consolidated
11.3 – Section 11	06/19/2017	T. Yen	Sample Management procedures
11.3 – Sections 20.3 & 3.5	06/19/2017	T. Yen	Ethic and Data Integrity moved to Section 20.3 and 3.5.
11.3 Section 12.6.5	06/19/2017	T. Yen	Validation of New Equipment Identification
11.3 Sections 12.6.7 & 12.6.8	06/19/2017	T. Yen	Out of Service Equipment
11.3 – Section 12.6.9	06/19/2017	T. Yen	Equipment status documentation.
11.3 – Section 12.8.2	06/19/2017	T. Yen	Continuing Calibration Blanks (CCB)
11.3 – Sections	06/19/2017	T. Yen	Record retention standardized to 10 years

Revision Number	Effective Date	Document Editor	Description of Changes
17.1 & 17.2			
11.3 – Section 21.1.9	06/19/2017	T. Yen	Procedure of amending report for correction or additional testing.
11.3 – Section 25	06/19/2017	T. Yen	References update.
11.3 – Section Appendix G	06/19/2017	T. Yen	Master SOP update.
11.3 Appendix A	06/19/2017	T. Yen	Acronym Update-Add Management of Change
11.3 – Section 22	06/19/2017	T. Yen	New section on Continuous Improvements
11.3-Section 23	06/19/2017	T. Yen	New Section on Management of Change
11.2	11/30/2016	T. Yen	Minor revision, update to certificates, staff and equipment list.
11.2 – Section 9.0	11/30/2016	T. Yen	Online survey procedure.
11.2 – Appendices	11/30/2016	T. Yen	Appendices updated.
11.1	7/31/2015	T. Yen	Minor revision, update to certificates, staff and equipment list.
11.1- Section 2.2	7/31/2015	T. Yen	SOP HS-GEN002 changed to CE-GEN001
11.1- Appendix J	7/31/2015	T. Yen	TX Cert updated to new version T104704231-15-15.
11.1- Appendix J	7/31/2015	T. Yen	LDEQ Cert update July1, 2015 – June 30, 2016.
11.0	2/28/2015	T. Yen	Minor revision, update to certificates, staff and equipment list.
10.0	2/28/2015	T. Yen	QAM format and sections.
10.0	2/28/2015	T. Yen	References for TCEQ QAPP 2014, DOD QSM 5.0, TNI 2009 updated
10.0 – Section 4.5	2/28/2015	T. Yen	Electronic Signature Policy added to QAM.
10.0 – Section 16.14.3	2/28/2015	T. Yen	QA in depth data monitoring.
10.0 – Section 21.1.1	2/28/2015	T. Yen	Non-accredited tests and analytes must clearly identified in reports.
10.0 Appendix J	2/28/2015	T. Yen	Primary TNI certificate insert to document accredited testing methods and

Revision Number	Effective Date	Document Editor	Description of Changes
			compounds.
09.2 09.1	11/19/2012 07/15/2012	T. Yen J. Cady	Management of Change in Appendix G Minor Revision – Utilized updated TNI acronym. Updated Organizational chart, Equipment list, SOP list, and Accreditation list. Logo policy included.
09.0	08/05/2011	J. Cady	Major Format Revision to 2009 TNI Standard
08.1	03/31/2011	I. Williams	Applied new document format. Deleted the following appendices: F-MDL/PQL G-LCS Limits

25) References for Quality System Standards, External Documents, Manuals, and Test Procedures

25.1 The following list represents key references for the laboratory quality program and systems.

25.1.1 TNI Standard – Environmental Laboratory Sector, Volume 1, Modules 1-Modules 7, Management and Requirements for Laboratories Performing Environmental Analysis, EL-V1M1 thru EL-V1M7, TNI 2009/2016

25.1.2 International Standard – General Requirements for the Competence of Testing and Calibration Laboratories, ISO/IEC 17025:2017(E)

25.1.3 Selected USEPA Approved Methods, 40 CFR, Part 136 including changes incorporated in the Methods Update Rule (MUR) published in 2019.

25.1.4 USEPA Methods published in Appendix A, B and C of 40 CFR, Part 136.

25.1.5 Standard Methods for the Examination of Water and Wastewater, 18th through Current Editions, Hard copy and/or Electronic Version.

25.1.6 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition, through Updates III (December 1996) and Update IV (February 2007), and new published methods online at http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm.

25.1.7 Selected USEPA Drinking Water methods published by the USEPA Office of Ground Water and Drinking Water

25.1.8 Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, (Revised March 1983).

25.1.9 Methods for the Determination of Inorganic Substances in Environmental Samples, EPA/600/R-93/100 (August 1993).

25.1.10 USEPA SW-846 Test Methods for Evaluating Solid Waste, 3rd Edition, through Updates III and VI, and published new methods from SW-846 (e.g. SW8270E).

25.1.11 *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91/010 (June 1991) and Supplements.

25.1.12 *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*,

25.1.13 EPA 600/4-82-057.

25.1.14 *Methods for the Determination of Organic Compounds in Drinking Water*,

25.1.15 EPA/600/4-88/039 and Supplements.

25.1.16 Selected APHA, AWWA, and ASTM methods.

25.1.17 *DoD Quality Systems Manual for Environmental Laboratories,* Current version

25.1.18 *Manual for the Certification of Laboratories Analyzing Drinking Water*, 5th Edition, EPA 815-B-97-001 (January 2005).

25.1.19 US EPA Region 9 QC Database, epa.gov/region9/qa/datatables.html.

25.1.20 State approved UST methods for TPH (e.g. TPH by TCEQ1005, Rev 3, June 2001).

25.1.21 TCEQ Quality Assurance Project Plan For Environmental Monitoring and Measurement Activities Relating to the Resource Conservation and Recovery Act (RCRA) & Underground Injection Control (UIC), Current Fiscal Year.

25.1.22 Perry Johnson Laboratory Accreditation, Inc. (PJLA), SOP-3 Accreditation Symbol Procedure Revision 1.7, October 2019.

25.1.23 *Procedure Manual for the Environmental Laboratory Accreditation Program,* Washington Department of Ecology, 10-03-048, September 2010.

25.1.24 Analytical Methods for Petroleum Hydrocarbons, ECY 97-602, Washington State Department of Ecology, June 1997.

25.1.25 Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, for USEPA and USACE (March 1986), with revisions through April 1997.

25.1.26 WDOE 83-13, Chemical Testing Methods for Complying with the State of Washington Dangerous Waste Regulations (March 1982) and as Revised (July 1983 and April 1991).

25.1.27 Identification and Listing of Hazardous Waste, California Code of Regulations, Title 22, Division 4.5, Chapter 11.

25.1.28 Analytical Methods for the Determination of Pollutants in Pulp and Paper Industry Wastewater, EPA 821-R-93-017 (October 1993).

25.1.29 Analytical Methods for the Determination of Pollutants in Pharmaceutical Manufacturing Industry Wastewaters, EPA 821-B-98-016 (July 1998).

25.1.30 National Council of the Pulp and Paper Industry for Air and Stream Improvement (NCASI)

26) Appendices

APPENDIX A – Glossary

The following are a list of acronyms used in this document and their definitions

AB	-	Accrediting Body
ANSI	-	American National Standards Institute
ASQC	-	American Society for Quality Control
ASTM	-	American Society for Testing and Materials
Blk	-	Blank
˚C	-	Degrees Celsius
cal	-	Calibration
CAS	-	Chemical Abstract Service
CCV	-	Continuing Calibration Verification
CoA	-	Certificate of Analysis
COC	-	Chain of Custody
DO	-	Dissolved Oxygen
DOC	-	Demonstration of Capability
DoD	-	Department of Defense
EPA	-	Environmental Protection Agency
g/L	-	Grams per Liter
GC/MS	-	Gas Chromatography/Mass Spectrometry
ICAL	-	Initial Calibration
ICP-MS	-	Inductively Coupled Plasma-Mass Spectrometry
ICV	-	Initial Calibration Verification
ISO/IEC	-	International Organization for Standardization/International Electrochemical Commission
lb/in2	-	Pound per Square Inch
LCS	-	Laboratory Control Sample
LCDS	-	Laboratory Control Duplicate Sample
LFB	-	Laboratory Fortified Blank
LOD	-	Limit of Detection
LOQ	-	Limit of Quantitation

MOC		-Management of Change
MDL	-	Method Detection Limit
mg/kg	-	Milligrams per Kilogram
mg/L	-	Milligrams per Liter
MS	-	Matrix Spike
MSD	-	Matrix Spike Duplicate
NELAC	-	National Environmental Laboratory Accreditation Conference
NELAP	-	National Environmental Laboratory Accreditation Program
NIST	-	National Institute of Standards and Technology
PT	-	Proficiency Test(ing)
PTP	-	Proficiency Testing Provider
PTPA	-	Proficiency Testing Provider Accreditor
QA	-	Quality Assurance
QAD	-	Quality Assurance Department
QAM	-	Quality Assurance Manager
QC	-	Quality Control
QM	-	Quality Manual
RL	-	Reporting Level
RPD	-	Relative Percent Difference
RSD	-	Relative Standard Deviation
SOPs	-	Standard Operating Procedures
SPK	-	Spike
STD	-	Standard
SV	-	Semi-Volatile (Organic Compound)
TNI	-	The NELAC Institute
ug/L	-	Micrograms per Liter
UV	-	Ultraviolet
VOC	-	Volatile Organic Compound

For the purpose of this Standard, the relevant terms and definitions conform to ISO/IEC 17011:2004 and ISO/IEC 17025: 2017. Additional relevant terms are defined below.

Accreditation Body: The territorial, state or federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation.
Accreditation Field of Proficiency Testing: Same as “Field of Proficiency Testing”.

Analysis Date: The calendar date of analysis associated with the analytical result reported for an accreditation or experimental field of proficiency testing.
Experimental Field of Proficiency Testing (Experimental FoPT): Analytes for which a laboratory is required to analyze a PT sample if they seek or maintain accreditation for the field of accreditation but for which successful analysis is not required in order to obtain or maintain accreditation.
Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.
Field of Proficiency Testing (FoPT): Analytes for which a laboratory is required to successfully analyze a PT sample in order to obtain or maintain accreditation, collectively defined as: matrix, technology/method, analyte.
Primary Accreditation Body (Primary AB): The accreditation body responsible for assessing a laboratory's total quality system, on-site assessment, and PT performance tracking for fields of accreditation.
Proficiency Testing (PT): A means to evaluate a laboratory's performance under controlled conditions relative to a given set of criteria, through analysis of unknown samples provided by an external source.
Proficiency Testing Program (PT Program): The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of results and the collective demographics and results summary of all participating laboratories.
Proficiency Testing Provider (PTP): A person or organization accredited by the TNI-approved Proficiency Testing Provider Accreditor to operate a TNI-compliant PT program.
Proficiency Testing Provider Accreditor (PTPA): An organization that is approved by TNI to accredit and monitor the performance of proficiency testing providers.
Proficiency Testing Sample (PT Sample): A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria.
Proficiency Testing Study (PT Study): A single complete sequence of circulation of proficiency testing samples to all participants in a proficiency test program.
PT Study Closing Date: The calendar date for which analytical results for a PT sample shall be received by the PT provider from the laboratory.
PT Study Opening Date: The calendar date that a PT sample is first made available to any laboratory by a PT provider.
Revocation: The total or partial withdrawal of a laboratory's accreditation by an accreditation body.
Study: This term refers to a PT Study or Supplemental PT Study.
Supplemental Proficiency Testing Study (Supplemental PT Study): A PT sample that may be from a lot previously released by a PT Provider that meets the requirements for supplemental PT samples given in Volume 3 of this Standard but that does not have a pre-determined opening date and closing date.
Suspension: The temporary removal of a laboratory's accreditation for a defined period of time, which shall not exceed six (6) months or the period of accreditation, whichever is longer, in order to allow the laboratory time to correct deficiencies or area of non-conformance with the Standard.
TNI PT Board: A board consisting of TNI members or affiliates, appointed by the TNI Board of Directors, which is responsible for the successful implementation and operation of the TNI Proficiency Testing Program. The duties of the TNI PT Board are defined in the TNI PT Board Charter.
Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents.
Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.
Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.
Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.
Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation).
Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.
Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one (1) to twenty (20) environmental samples of the same quality systems matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be twenty-four (24) hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples.
Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).
Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. Blanks include:
Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.
Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards.

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).
2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration Standard: A substance or reference material used for calibration.
Certified Reference Material (CRM): Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute.
Chain of Custody Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of

containers; the mode of collection; the collector; time of collection; preservation; and requested analyses.
Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: Second column confirmation, Alternate wavelength, Derivatization, Mass spectral interpretation, Alternative detectors, or Additional cleanup procedures.
Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more useful form.
Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.
Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.
Finding: An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement.
Holding Times: The maximum time that can elapse between two specified activities.
Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.
Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.
Legal Chain of Custody Protocols: Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain of
Custody Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.
Limit(s) of Detection (LOD): A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility.
Limit(s) of Quantitation (LOQ): The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.
Matrix: The substrate of a test sample.
Matrix Duplicate: A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.
Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.
Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.
Measurement System: A method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s).
Method: A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.
Mobile Laboratory: A portable enclosed structure with necessary and appropriate accommodation and environmental conditions for a laboratory, within which testing is performed by analysts.

Examples include but are not limited to trailers, vans, and skid-mounted structures configured to house testing equipment and personnel.

National Institute of Standards and Technology (NIST): A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (NMI).

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis.

Procedure: A specified way to carry out an activity or process. Procedures can be documented or not.

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories.

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria.

Protocol: A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed.

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control.

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC) activities.

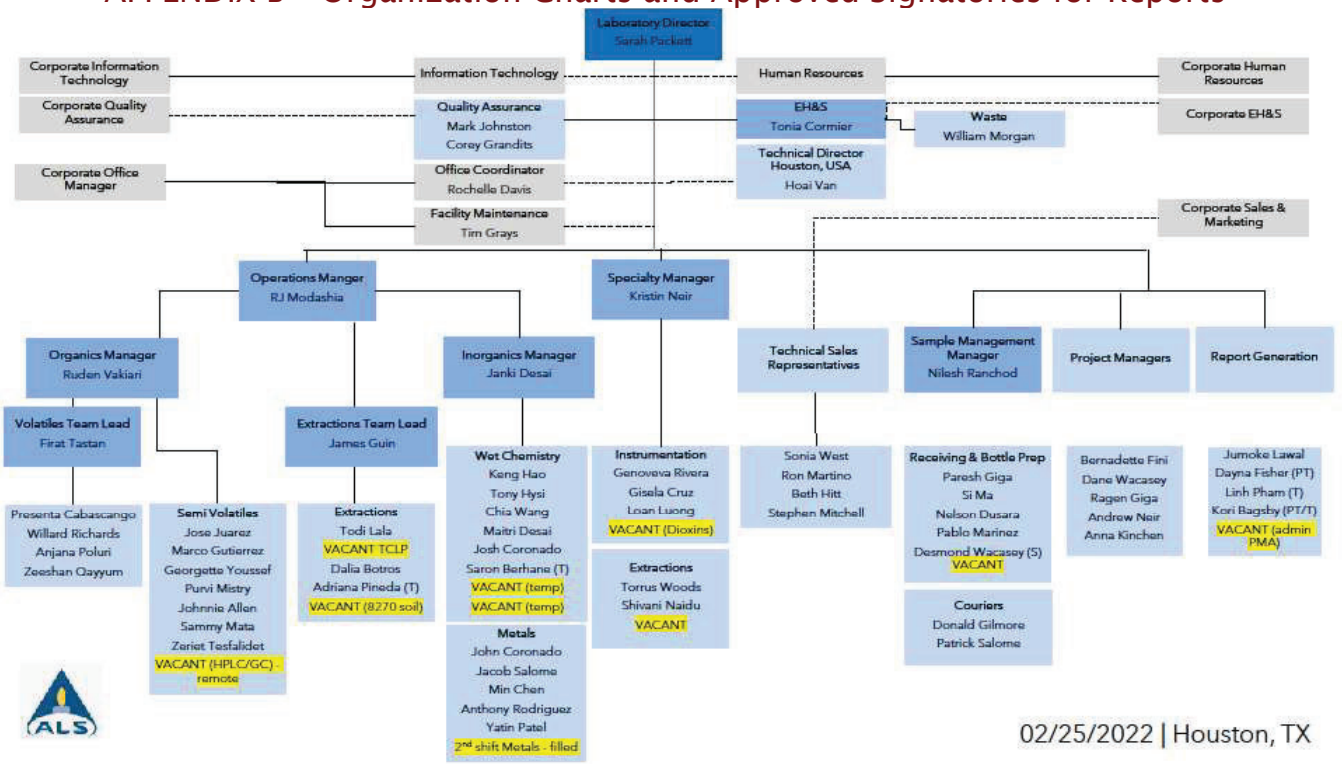
Quality System Matrix: These matrix definitions are to be used for purposes of batch and quality control requirements:

- **Air and Emissions:** Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device.

- **Aqueous:** Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, ground water effluents, and TCLP or other extracts.
- **Biological Tissue:** Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.
- **Chemical Waste:** A product or by-product of an industrial process that results in a matrix not previously defined.
- **Drinking Water:** Any aqueous sample that has been designated a potable or potential potable water source.
- **Non-Aqueous Liquid:** Any organic liquid with <15% settleable solids.
- Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.
- **Solids:** Includes soils, sediments, sludges and other matrices with >15% settleable solids.

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records.
Reference Material: Material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.
Reference Standard: Standard used for the calibration of working measurement standards in a given organization or at a given location.
Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.
Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system.
Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.
Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.
Standard Operating Procedures (SOPs): A written document that details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks.
Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.
Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.
Verification: Confirmation by examination and objective evidence that specified requirements have been met. NOTE: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

APPENDIX B – Organization Charts and Approved Signatories for Reports

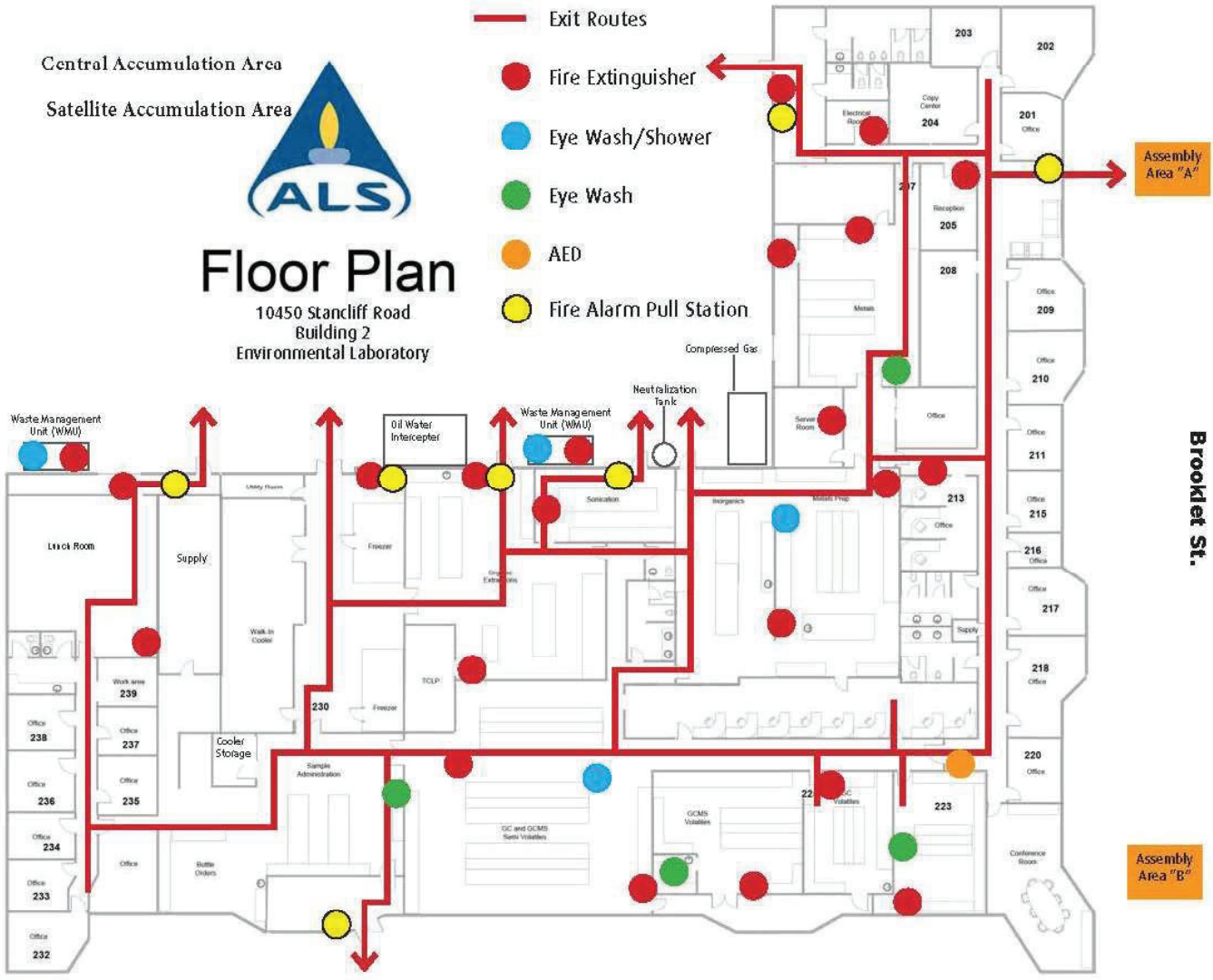


Approved Signatories for Analytical Reports only

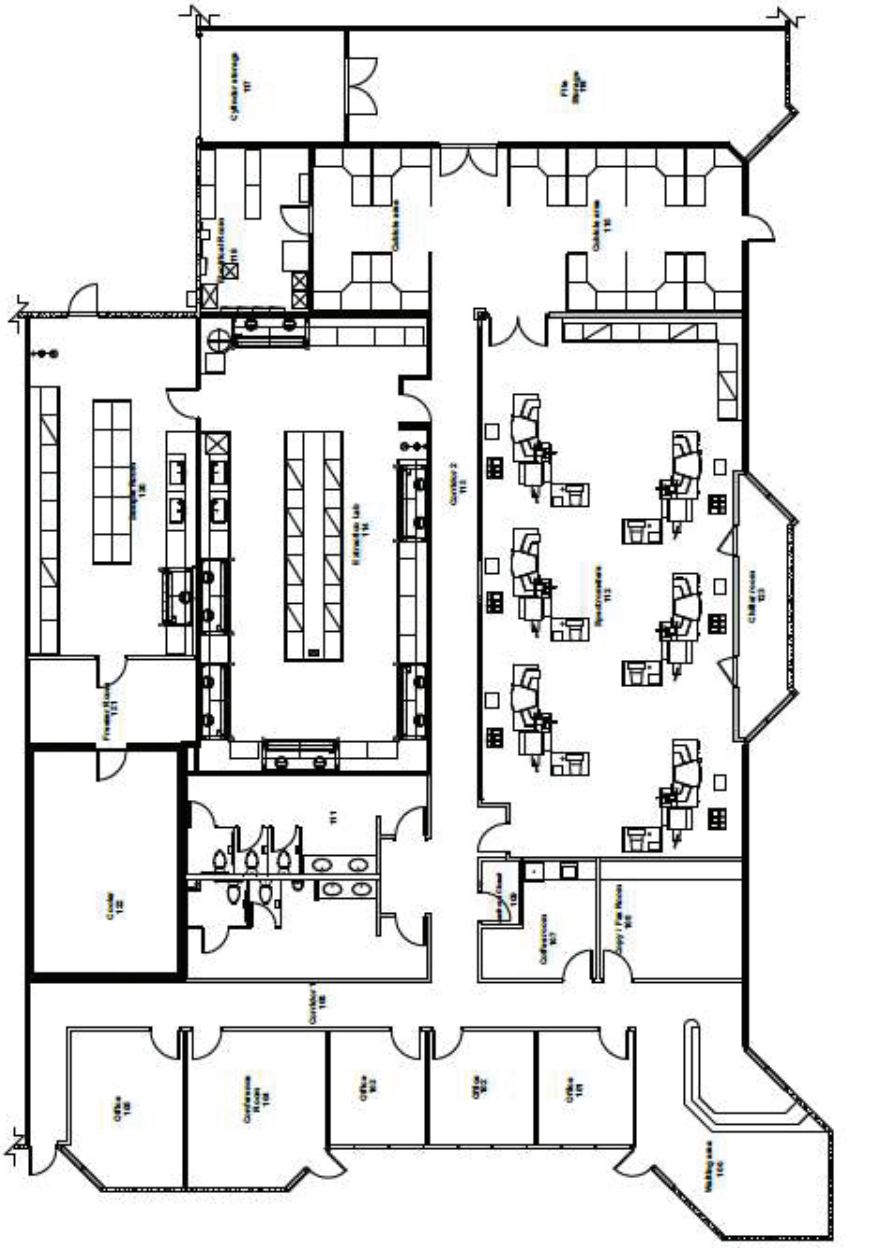
Sarah Packett	Laboratory Director
Hoai Van	Technical Director
Kristin Neir	HRMS Department Manager
Mark B. Johnston	Quality Manager
Bernadette Fini	Project Manager
Ragen Giga	Project Manager

Dane Wacasey	Project Manager
Corey Grandits	Project Manager/QA Generalist

APPENDIX C.1 –FS Laboratory Floor Plan



APPENDIX C.2 – HRMS Laboratory Floor Plan



APPENDIX D – Containers, Preservation and Holding Times

Parameter	Containers [1]	Preservative	Holding Time [2]
Acidity / E305.1	P, G - 250 mL	>0 to 6 ° C	14 days
Alkalinity / SM 2320B – E310.1	P, G - 250 mL	>0 to 6 ° C	14 days
Ammonia as N	P, G – 250 or 500 mL	>0 to 6 ° C; H_2SO_4 to pH<2	28 days
Bacterial Tests (Coliform, Total, Fecal and *E. Coli*)	PA, G – 125-mL	Cool <10 ° C; 0.008% $Na_2S_2O_3$ if Cl_2 present	8 hours
Biological Oxygen Demand (BOD)	P, G – 1000 mL	>0 to 6 ° C	48 hours
(Carbonaceous) Biological Oxygen Demand (CBOD)	P, G – 1000 mL	>0 to 6 ° C	48 hours
Bromide	P, G – 500 mL	None required	28 days
(Total Organic) Carbon (TOC) / SW 9060	P, G – 125 amber mL or 40 mL amber vial	>0 to 6 °C; HNO_3 or H_2SO_4 to pH<2	28 days
Chemical Oxygen Demand (COD)	P, G – 250 mL	>0 to 6 ° C; H_2SO_4 to pH<2	28 days
Chloride	P, G – 250 mL	None required	28 days
Chlorine, Residual	P, G – 120 mL	>0 to 6 ° C	15 minutes
Color	P, G – 250 mL	>0 to 6 ° C	48 hours
Conductivity (Spec. Conductance)	P, G – 250 mL	>0 to 6 ° C	28 days
(Reactive) Cyanide	P, G – 4 oz wm	None required	14 days
Cyanide (Total and Amenable to Chlorination)	P, G - 500 mL	>0 to 6 ° C; NaOH to pH>12; 0.6g ascorbic acid	14 days
Cyanide (Total or Reactive) / Soil	P, G – 100 g in 250-ml wm bottle.	>0 to 6 ° C	14 days
Fluoride	P – 250 mL	None required	28 days
Hardness	P, G – 250 mL	HNO_3 or H_2SO_4 to pH<2	6 months
Nitrate as N	P, G – 250 mL	>0 to 6 ° C	48 hours
Nitrate-Nitrite as N	P, G – 250 mL	>0 to 6 ° C; H_2SO_4 to pH<2	28 days
Nitrite as N	P, G – 250 mL	>0 to 6 ° C	48 hours
(Total Kjeldahl) Nitrogen	P, G – 250 mL	>0 to 6 ° C; H_2SO_4 to pH<2	28 days
Oil and Grease	G – 1000 mL wm	>0 to 6 ° C; H_2SO_4 to pH<2	28 days
Oxygen, Dissolved	P, G – 1000 mL	>0 to 6 ° C	15 minutes
pH (hydrogen ion)	P, G – 250 mL	>0 to 6 ° C	15 minutes
(Total) Phenols (wet method)	G / amber – 1000 mL	>0 to 6 ° C; H_2SO_4 to pH<2	28 days
(*ortho*-) Phosphate	P, G – 250 mL	Filter immediately; >0 to 6 ° C	48 hours
(Total) Phosphate	P, G – 250 mL	>0 to 6 ° C; H_2SO_4 to pH<2	28 days
Residue (Total Solids)	P, G – 500 mL	>0 to 6 ° C	7 days
Residue (Dissolved Solids) (TDS)	P, G – 500 mL	>0 to 6 ° C	7 days
Residue (Suspended Solids) (TSS)	P, G – 1000 mL	>0 to 6 ° C	7 days
Residue (Settleable)	P, G – 1000 mL	>0 to 6 ° C	48 hours
Residue (Total Volatile) (TVS)	P, G – 500 mL	>0 to 6 ° C	7 days

Parameter	Containers [1]	Preservative	Holding Time [2]
Residue (Volatile Suspended) (TVSS)	P, G – 1000 mL	>0 to 6 ° C	7 days
Silica	P – 500 mL	>0 to 6 ° C	28 days
Sulfite	P, G – 250 mL	>0 to 6 ° C	15 minutes
Chromium VI	P, G – 250 mL	>0 to 6 ° C	24 hours
Chromium VI (soil)	P, G – 4 oz wide mouth	>0 to 6 ° C	24 hours
Mercury	P, G – 500 mL	HNO_3 to pH<2	28 days
Mercury (soil)	P, G – 4 oz wm bottle	None	28 days
Metals (except Chromium IV and Hg)	P, G – 500 mL	HNO_3 to pH<2	6 months
Metals (except CrVI and Hg)/ (soil)	P, G – 50 g in 120 mL bottle	None	6 months
TCLP Mercury	P, G – 1000 mL	>0 to 6 ° C	28 days to extract; 28 days after extraction to analysis
TCLP Metals (except Mercury)	P, G – 1000 mL	>0 to 6 °C	180 days to extract; 180 days after extraction to analysis
Dioxins/Furans in water or drinking water EPA 1613B	G – 2 x 1L amber	>0 to 6 ° C; 0.008% $Na_2S_2O_3$ if Cl_2 is present	1 year [7]
Dioxins/Furans in soil EPA 1613B	G – wide-mouth 4 oz amber jar	Transport: <4°C; dark Storage: <10°C; dark	Samples:1 year Extracts: 1 year
Dioxins/Furans in tissue EPA 1613B	G – wide-mouth 4 oz amber jar	Transport: <4°C; dark Storage: <10°C; dark	Samples:1 year Extracts: 1 year
Dioxins/Furans in water EPA 8290A	G – 2 x 1L amber	>0 to 6 ° C	30 days to extract; 45 days after extraction to analysis
Dioxins/Furans in soil EPA 8290A	G – wide-mouth 4 oz amber jar	Transport: <4°C; dark Storage: <10°C; dark	30 days to extract; 45 days after extraction to analysis
Dioxins/Furans in tissue EPA 8290A	G – wide-mouth 4 oz amber jar	Transport: <4°C; dark Storage: <10°C; dark	30 days to extract; 45 days *after collection* to analysis
Dioxins/Furans in Air EPA Method 23	XAD	>0 to 6 ° C; dark	30 days to extract; 45 days after extraction to analysis
Dioxins/Furans in Air EPA TO-9A	PUF	>0 to 6 ° C; dark	7 days to extract; 40 days after extraction to analysis
Pesticides in Soil (Organochlorine) 8081B	G, 4 oz wide mouth	>0 to 6 °C	14 days to extract; 40 days after extraction to analysis
Pesticides – water (Organochlorine)/8081B	Amber G, 2 x 1L	>0 to 6 °C; adjust pH to 4-5	7 days to extract; 40 days after extraction to analysis
Perchlorate in water EPA 6850	P- 125 mL with headspace	>0 to 6 °C; filter (0.2 µm PTFE) in field if possible	28 days

Parameter	Containers [1]	Preservative	Holding Time [2]
Perchlorate in Soil EPA 6850	G – wide-mouth 4 oz amber jar	>0 to 6 °C	28 days to extract; 28 days after extraction to analysis
PCBs in Soil [4] SW 8082A	G, 4 oz wide mouth	>0 to 6 ° C	14 days to extract; 40 days after extraction to analysis
PCBs in water[4,5] SW 8082A / EPA 608	Amber G; 2 x 1L	>0 to 6°C; adjust pH to 4-5	7 days to extract; 40 days after extraction to analysis
(Total) Petroleum Hydrocarbons (TPH) Water – by TX 1005	G – 2 x 40 mL with no headspace	>0 to 6 °C; HCl to pH<2	14 days to extract; 14 days after extraction to analysis
(Total) Petroleum Hydrocarbons (TPH) Water – by TX 1005	2 - 5 gram samples in pre-tared 40 ml VOA vial	>0 to 6 ° C; freeze samples to –12 to -20 ° C within 48 hrs	14 days to extract; 14 days after extraction to analysis
Polynuclear Aromatic Hydrocarbons (PAHs) / (soil)	G, 4 oz wide mouth	>0 to 6 ° C; store in the dark	14 days to extract; 40 days after extraction to analysis
Polynuclear Aromatic Hydrocarbons (PAHs) by 8270 (water)	Amber G; 2 x 1L LVI: AG – 3 x 40 mL with no headspace	>0 to 6 ° C	7 days to extract; 40 days after extraction to analysis
Semi-Volatiles (BNAs) in soil	G, 4 oz wide mouth	>0 to 6 ° C	14 days to extract; 40 days after extraction to analysis
Semi-Volatiles (BNAs)	Amber G, 2 x 1L	>0 to 6 ° C	7 days to extract; 40 days after extraction to analysis
Semi-Volatiles (TCLP)	G, 4 o wide mouth	>0 to 6 ° C	14 days to TCLP extraction; 7 days from TCLP extraction to BNA extraction; 40 days after BNA extraction to analysis
Total Organic Halogens (TOX) / SW9020	Amber G, 250mL	>0 to 6 ° C; H_2SO_4 to pH<2	28 days
Volatiles (water) SW 8260B	G – 3 x 40 mL with no headspace	>0 to 6 ° C; HCl to pH<2	14 days
Volatiles (TCLP)	G, 2 x 4 oz wide mouth	>0 to 6 ° C	14 days to extract; 14 days after extraction to analysis
Volatiles (low level soil by 5035A, where soil likely contain VOCs < 200 ppb)	Collect sample using approved coring device (EnCore, etc) or field preserve 5 gram sample in pre-tared 40 ml VOA vial, containing 5ml of organic free water, 1g sodium bisulfate & stir bar	>0 to 6 ° C; or freeze[3] samples to –12 to -20 ° C as an alternative to preservation with sodium bisulfate as a means to inhibit biodegradation.	48 hrs to transfer contents of core device to a 40 ml VOA vial , containing 5ml of organic free water, 1g sodium bisulfate & stir bar; analyze transferred sample 14 days from collection

Parameter	Containers [1]	Preservative	Holding Time [2]
Volatiles (high level soil by 5035A, where soil may contain VOCs >200 ppb)	Collect sample using approved coring device (EnCore, etc) or field preserve samples in pre-tared 60 ml glass bottles with methanol	>0 to 6 ° C; or freeze[3] samples to -12 to -20 ° C as an alternative to preservation with methanol as a means to inhibit biodegradation.	48 hrs to transfer contents of core device to a 40 ml VOA vial , containing 10 ml of purge and trap grade methanol; analyze methanol preserved sample 14 days from collection
Volatiles (Soil)	G, 2 oz wide mouth[6]	>0 to 6 ° C	14 days
Alpha, Beta, and Radium	P, G – 1000 mL	HNO_3 to pH<2	6 months

[1] (P) polyethylene/plastic; (G) Glass; (PA) Autoclavable Plastic, PUF = Polyurethane foam plug, XAD = XAD filled glass trap

[2] Recommended Holding Times from 40CFR136 and/or USEPA SW-846.

[3] Option to freeze core soil must be approved by regulatory agency or QA Project Plan.

[4] SW-846, Revision 4, February 2007, Chapter 4, Table 4-1, No Holding Time for PCBs.

[5] 40 CFR Part 136, (7-1-09 Edition), Table II, Maximum Holding Time1 year until extraction, 1 year after extraction.

[6] The prefer solid volatiles sampling method for TCEQ is 5035A and if sample in bulk jar, reports must be narrate as being receipt in improper containers.

[7] Manual for the Certification of Laboratories Analyzing Drinking Water, fifth Ed, Chapter IV, page 27 recommends a 40 day holding time for extracts analyzed by 1613B.

APPENDIX E – Data Qualifiers

Qualifier	Description
*	Value exceeds Regulatory Limit
a	Not accredited
n	Not offered for accreditation
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
J	Analyte detected below quantitation limit
M	Manually integrated, see raw data for justification
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL
P	Chlorodiphenyl ether interference was present at the Retention Time of the target analyte. Reported result should be considered an estimate. HRMS only
Q	Monitored lock-mass indicates matrix interference. Reported result should be considered an estimate. HRMS only
S	Signal saturated the detector. Result reported from dilution. HRMS only
X	See case narrative
Y	Isotopically Labeled Standard recovery outside of acceptance limits. In all cases, the signal-to-noise ratios are greater than 10:1, making the recoveries acceptable. HRMS only
K	The ion abundance ratio between the primary and secondary ions were outside of theoretical acceptance limits. Reported result should be considered an estimate. HRMS only
i	The MDL/MRL have been elevated due to a matrix interference. HRMS only

Acronym	Description
DCS	Detectability Check Study
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MBLK	Method Blank
MDL	Method Detection Limit
MQL	Method Quantitation Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PDS	Post Digestion Spike
PQL	Practical Quantitation Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

APPENDIX F – Laboratory Accreditations and Scopes

Accrediting Body	Certificate Number*	Expiration Date
Arkansas	21-022-0	3/27/2022
California	2919	4/30/2022
Arizona	AZ0793	5/27/2022
DoD (PJLA) ***	L21-682; L22-90	12/31/2023;2/28/2022
Florida*	E87611	6/30/2022
Hawaii	---	4/30/2022
Illinois	2000322020-4	5/9/2022
Kansas	E-10352	7/31/2022
Kentucky	123043	4/30/2022
Louisiana**	03087	6/30/2022
Louisiana DoH	LA028	12/31/2022
Maryland	343	6/30/2022
Maine	2020016	6/5/2022
Michigan	9971	4/30/2022
Minnesota	2228443	12/31/2022
Nebraska	NE-OS-25-13	4/30/2022
New Hampshire	209421	4/24/2022
New Jersey	TX008	6/30/2022
New York	11707	3/31/2022
Nevada	TX026932022-1	7/31/2022
North Carolina	624	12/31/2022
North Dakota	R-193	4/30/2022
Oklahoma	2021-080	8/31/2022
Pennsylvania	015	6/30/2022
Tennessee	04016	4/30/2022
Texas**	T1014704231-21-28	4/30/2022
Utah	TX026932021-12	7/31/2022
Washington	C819-21	11/14/2022
USDA Soil Permit	P330-19-00299	10/10/2022

All certificates and scopes can be found on the laboratory's secure network and through the Certificates database in Sharepoint.

*Certificate number at time of QAM generation, Certificate Number or list may have changed, please contact lab most recent listing.
**Primary TNI Accreditation Body
***The scope for DoD is attached per current QSM requirement at §4.2.8.4 y).

Primary Scope of Accreditation for DoD (double-click on each page to obtain the full scope)

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

ALS Group USA Corp
10450 Stancliff Road, Suite 210, Houston, TX 77099

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2017 General Requirements for the competence of Testing and Calibration Laboratories and the United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP) requirements identified within the DoD/DOE Quality Systems Manual (DoD/DOE QSM) Version 5.3 May 2019 and is accredited is accordance with the:

United States Department of Defense
Environmental Laboratory Accreditation Program
(DoD-ELAP)

This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system
(as outlined by the joint ISO-ILAC-IAF Communiqué dated April 2017):

Environmental Testing
(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Tracy Szerszen
President

Perry Johnson Laboratory Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

Initial Accreditation Date:	*Issue Date:*	*Expiration Date:*
August 21, 2020	November 9, 2021	December 31, 2023

Accreditation No.:	*Certificate No.:*
111808	L21-682

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

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PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

ALS Houston
10450 Stancliff Rd. Suite 115, Houston, TX 77099

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2017) General Requirements for the competence of Testing and Calibration Laboratories and the United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP) requirements identified within the DoD/DOE Quality Systems Manual (DoD/DOE QSM) Version 5.4 October 2021 and is accredited is accordance with the:

United States Department of Defense
Environmental Laboratory Accreditation Program
(DoD-ELAP)

This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system
(as outlined by the joint ISO-ILAC-IAF Communiqué dated April 2017):

Environmental Testing
(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Tracy Szerszen
President

Perry Johnson Laboratory Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

Initial Accreditation Date:	*Issue Date:*	*Expiration Date:*
October 25, 2021	January 27, 2022	March 31, 2024

Accreditation No.:	*Certificate No.:*
116454	L22-90

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

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APPENDIX G – Calibration Criteria and DQOs

Table K.1 Calibration And Maintenance Schedule – Houston Facility

Instrument	Activity	Frequency	Documentation
pH Meters	Calibration: pH buffer aliquots are used only once Buffers used for calibration will bracket the pH of the media, reagent, or sample tested.	Before use	Worksheet/log book
pH/Specific Ion Meter	Calibration/check slope Clean electrode	Daily As required	Worksheet/log book
pH probe / ISE probes	Maintenance: Use manufacturer's specifications	As needed	Worksheet/log book
UV-Vis Spectrophotometer	Clean ambient flow cell Precision check/alignment of flow cell Wavelength verification check with color standards Empty Waste and/or Fill Rinse Containers (Gallery)	As required As required Semi-annually As Needed	Worksheet/log book Post service date on Unit
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As required As required	Temperature Tracking Log Maintenance Logbook
BOD Incubator	Temperature monitoring Coil and incubator cleaning	Daily Monthly	Temperature Tracking Log Maintenance Logbook
Refrigerators, Freezers, and BOD incubators	1. Thermometers are immersed in liquid to the appropriate immersion line 2. The thermometers are graduated in increments of 0.5°C or less	Temperatures are recorded each day in use	Worksheet/log book
DO Meter	Calibrate as specified in SOP	Before use	Worksheet/log book
DO probe	Maintenance as specify by manufacturer	As needed	Worksheet/log book
CETAC Mercury Analyzer	Check tubing for wear Fill rinse tank with 10% HCl Insert clean drying tube filled with Magnesium Perchlorate Fill reductant bottle with 10% Stannous Chloride	Daily Daily Daily Daily	Worksheet/log book

Table K.1 Calibration And Maintenance Schedule – Houston Facility

Instrument	Activity	Frequency	Documentation
	Clean/ Align/ Lubricate Autosampler	As Needed	
	Linear Range Study	Semi-annually	
ICP/MS	Check pump tubing	Daily	Worksheet/log book
	Check liquid argon supply	Daily	
	Check fluid level in waste container	Daily	
	Check filters	Weekly	
	Clean or replace filters	As required	
	Check torch	Daily	
	Check sample spray chamber for debris	Monthly	
	Clean and align nebulizer	Monthly	
	Check entrance slit for debris	Monthly	
	Change printer ribbon	As required	
	Replace pump tubing	As required	
	Install cleaned/new skimmer cones	As needed	
	Linear Range Study	Semi-annually	
GC/MS Systems	Ion gauge tube degassing	As required	Worksheet/log book
	Pump oil-level check	Monthly	
	Diffusion Pump oil changing	Annually	
	Analyzer bake-out	As required	
	Analyzer cleaning	As required	
	Resolution adjustment – Tune MSD	As required	
	Auto sampler maintenance	As required	
	Purge and Trap maintenance	As required	
Electron Capture Detector (ECD)	Detector wipe test (Ni-63)	Semi-annually	Worksheet/log book
	Detector cleaning	As required	
	Detector refoiled	As needed	
Gas Chromatograph	Compare standard response to previous day or since last initial calibration	Daily	Worksheet/log book
	Check carrier gas flow rate in column	Daily via use of known RT	
	Check temp. of detector, inlet, column oven	Daily	
	Septum replacement	As required	
	Glass wool replacement	As required	
	Check system for gas leaks with SNOOP	W/cylinder change as required	
	Check for loose/fray wires and insulation	Monthly	
	Bake injector/column	As required	
	Change/remove sections of guard column	As required	
	Replace connectors/liners	As required	
	Change/replace column(s)	As required	
	Autosampler Maintenance	As required	

Table K.1 Calibration And Maintenance Schedule – Houston Facility

Instrument	Activity	Frequency	Documentation
Flame Ionization Detector (FID)	Detector cleaning	As required	Worksheet/log book
Photoionization Detector (PID)	Change O-rings Clean lamp window Replace PID Lamp	As required As required As needed	Worksheet/log book
HPLC / IC units	Change guard columns Change lamps Change pump seals Replace tubing Change fuses in power supply Filter all samples and solvents Change autosampler rotor/stator	As required As required Semi-annually or as required As required As required Daily As required	Worksheet/log book
TOC Analyzer	Check Sample Delivery Tubing Check Gas and Reagent supplies Replace Catalyst IR Detector cleaning	Daily Daily As required As required	Maintenance Log
Balances	Class "S" traceable weight check Clean pan and check if level Field service	Daily, when used Daily At least annually	Calibration Log
Conductivity Meter	0.01 M KCl calibration Conductivity cell cleaning	Daily, when used As required	
Turbidimeter	Check light bulb Calibrate using three points, use fresh standards daily Linear Range Study	Daily, when used Daily Semi-annually	
Deionized Water	Check resistance Check deionizer light Monitor for VOA's Replace cartridge & large mixed bed resins	Daily Daily Daily As required	DI Water Log
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required	Temperature Tracking Log
Auto analyzer (Gallery)	Clean surfaces and waste container Clean cuvette waste bin, racks, probes, mixer paddle, wash wells and wipe off moisture. Clean incubator and water containers	Daily Weekly Monthly	Maintenance Log
Auto analyzer (Mantech)	Empty waste, check pH, keep rinse solution clean Replace seed lines Replace dilution, inhibitor line Replace all tubes, electrodes Clean Carboys	Daily Quarterly Semi-annually As Needed Weekly	Maintenance Log
Microwave Oven	Clean Cavity Replace Door Shield	Daily As Needed	

Table K.1 Calibration And Maintenance Schedule – Houston Facility			
Instrument	**Activity**	**Frequency**	**Documentation**
Water Chiller	Clean Coils Add coolant	Monthly As Needed	

QUALITY ASSURANCE PLAN

Bridger Analytical Lab
7539 Pioneer Way, Suite B
Bozeman, MT.

Phone: (406)-582-0822

Revision Number: 2.1
Date: December, 2020

_____ _____
Laboratory Manager Date
Andy Frame, Ph.D.

_____ _____
Quality Assurance Officer Date
Andy Frame, Ph.D.

Table of Contents

Introduction

This manual describes the quality assurance/quality control (QA/QC) system currently in place in the Inorganic and Microbiology laboratories at Bridger Analytical Lab (BAL). Any QA/QC matters directly related to BAL will be addressed in this document. The QA manual is intended to provide a working knowledge of daily operational procedures used to control the quality of work performed in the laboratory. These procedures have been established to show that BAL is committed to producing both scientifically and legally defensible data.

Bridger Analytical Lab will provide both chemical and microbiological analyses to a wide range of clients but not limited to: private individuals, home inspectors/realtors, environmental firms, and engineering consultants. Analytical services will initially include the analysis of aqueous samples for inorganic and microbiological parameters.

The quality control program will create acceptable performance criteria for all routine procedures performed at the laboratory. The QA manual is the first step in creating a complete Quality Assurance Program (QAP) that will guide the laboratory in creating a quality product. The QA manual is a living document that will be revised as the laboratory grows and reviewed, at a minimum, on a yearly basis.

Purpose and scope of the Quality Assurance Plan

The objective of the Bridger Analytical Lab QA plan is to provide a consistent documented policy that will be applicable to and used by laboratory administration, sample login, inorganic chemistry and microbiology laboratory operations.

Quality Assurance Statement

It is the goal of Bridger Analytical Lab to implement a Quality Assurance Plan (QAP) for all environmental activities that generate analytical data. The QAP is a management tool that will help guarantee that data is of sufficient known quality to withstand scientific and legal challenge relative to the use for which the data is obtained.

1 Laboratory Qualifications

1.1 Responsibilities and Authorities: Executing an effective QA program demands the commitment of both management and staff. The QA effort at the chemistry and microbiology laboratory is directed by the Laboratory

Manager. The implementation of the QA program within the laboratories is the responsibility of the QA officer. In addition, all analysts within the labs play a vital role in assuring the quality of their work.

Laboratory Manager

Responsibilities

- Ultimate responsibility for the quality for the data produced by Bridger Analytical Lab.
- Defining QA Policy.
- Directing QA program.
- Delegation of Quality Assurance to QA Officer.
- Actively supporting the implementation of the QA Program within the laboratory.
- Maintaining the work environment that emphasizes the importance of the data quality.

Authority

The Laboratory Manager is the final authority within the laboratory on all issues dealing with data quality. The Laboratory Manager has the authority to accept or reject data based on compliance with the well-defined QC criteria, or based on technical reasons. These circumstances must be well documented and any need for corrective action must be defined and initiated.

Quality Assurance Officer

Responsibilities

- Managing QA program.
- Orders proficiency testing (PT) and reference standard samples.
- Initiating and monitoring corrective actions.
- Monitoring the preparation and verification of analytical standards.
- Monitoring general QA practices.
- Maintaining records and archives of proficiency testing results, audit comments, MDL studies, and customer inquires about data quality.
- Reviewing and controlling SOPs.
- Preparing and revising QA Plan.

Authority

The QA Officer has authority within the laboratory on all issues dealing with data quality. The QA Officer has the authority to require that procedures be amended or discontinued or analyses suspended or repeated.

Laboratory Personnel

Responsibilities

- Have a working knowledge of the QA program as documented in the QA Plan.
- Ensuring that all work is generated in compliance with the QA plan and applicable written SOPs.
- Maintaining current SOPs for analytical procedures.
- Ensuring that all documentation related to their work is complete and accurate.
- Providing management with immediate notification of quality problems
- Peer review of data.

1.2 Demonstration of Laboratory Capability: Performance of any analytical method requires that the proper facilities, equipment and instrumentation are available for laboratory personnel to perform the required tasks. Once the facilities and equipment are in place detailed Standard Operating Procedures (SOPs) must be put in place to ensure quality data.

1.3 Facilities, Equipment, and Standard Operating Procedures (SOP)

1.3.1 Facilities: A detailed description of the laboratory is located in Appendix A.

1.3.2 Equipment and Preventive Maintenance: An equipment list is attached in Appendix B. Preventive maintenance is performed routinely on each analytical instrument by qualified personnel. The laboratory maintains detailed logbooks or computerized records documenting the preventive maintenance and repairs performed on each analytical instrument. At a minimum, this includes:

- Description of the problem.
- Date that the problem was realized and resolved.
- Description of corrective action.

1.3.3 Standard Operating Procedures (SOPs)

1.3.4 SOPs are written for all methods and instruments in laboratory. Information for the SOPs can come from a variety of sources; however in general most of the information comes from both established certified methods and instrument manufacturer's operation manuals. For more complex technical instrumentation an on site training is sometimes supplied with the cost of the instrument and is a valuable source of information for SOP writing. Records of onsite training will be kept with the QA officer for use in official SOPs. (Onsite training will be discussed further in Chapter 3 of this manual)

1.3.5 SOPs will initially be separated into two distinctive categories:

1. Administrative SOPs
2. Laboratory SOPs

1.3.5.1 Administrative SOPs will detail such functions as sample login, record keeping, data reporting, training records, SOP writing, etc….

1.3.5.2 The laboratory SOPs contain details on analytical methods, describe the operational procedures for the instrumentation and the required QA/QC limits for the methods, for general laboratory practices including , but are not limited to, operations such as glassware washing, use of satellite waste disposal areas, and safety procedures etc…..

1.3.6 All SOPs are approved by the QA Officer and the Laboratory Manager before being implemented. The distribution of current SOPs and archiving of outdated documents are controlled by the QA Officer. SOPs must be reviewed annually to insure accuracy and completeness. This review is the responsibility of the primary user. However, the QA Officer periodically reviews the integrity of the SOPs.

1.3.7 The QA Officer maintains the original copies of the SOPs and is the individual responsible for controlling the documents.

1.3.8 The master SOPs are catalogued in binders per analysis group: Inorganic, Microbiology and Administrative SOPs are controlled by the QA officer. This master collection of SOPs is the primary document control system in the laboratory. All laboratory personnel will have access to the appropriate SOPs via the QA officer and is used during the training process. The QA officer may supply copies to the lab personnel, but must control the copies by stamping them as such with an official stamp and initialing the SOP as a copy. Only the QA officer can control the original copies under lock and key. Eventually it is the goal of BAL to have them

linked in the Laboratory Information Management System (LIMS) based on or tied to the appropriate method. For additional information on SOPs see Section 5.1 referring to laboratory documentation.

1.3.9 SOPs and method references are summarized in Appendix C.

1.4 Demonstration of Analysts Ability to Generate Data: BAL administrative staff is responsible for ensuring that each laboratory staff member is capable and qualified to perform analytical methods currently used in the laboratory. Training records are maintained for all analysts with the QA officer along with their summary of qualifications. (Appendix D).
More detailed information on demonstration of ability can be found in chapter 3 under training records in the QA document).

1.5 Acceptable Accuracy and Precision: All analytical methods are subjected to quality control monitoring. The intention is to show that results generated meet acceptable accuracy and precision criteria for the method. Quality control requirements are outlined in the methods and BAL at a minimum follows the guidelines specified in the methods used. (For more detailed information regarding parameters used to monitor accuracy and precision see Chapter 6, section 6.8 of this QA manual).

1.6 Performance Evaluation (PE) Samples: PE samples are supplied by an outside source (i.e. Environmental Resource Associates). The laboratory does not have knowledge of the known values prior to the analysis of the PE samples. Only the PE provider has knowledge of constituent levels prior to the formal publishing of the test results. These types of external PE samples are analyzed on a semi-annual basis, with results sent to the reference supplier for evaluation. Acceptable results are those which are a defined range as determined by the vendor. Results are sent by the provider to the appropriate certifying agency.

1.7 Quality Control Check Samples: Quality control check samples or laboratory control standards (QCS or LCS) are considered a second source standard used to verify that the calibration standards are accurate for each method. These standards are purchased from an outside vendor and each QCS comes with a certificate of analysis along with the acceptable ranges. These samples are run with each analytical batch as if it were an actual sample, and verified relative to the certificate of analysis.

2 Sample Management and Sample Receiving Procedures

2.1 Sample Acceptance Policy: The Laboratory Manager has ultimate authority to decide on the acceptance of samples. Most of the testing is done for

water samples from private wells and public drinking water systems. All samples are accepted as capacity and capability allow. Samples the lab cannot analyze are contracted out. If neither the laboratory nor contracted services are available, the requestor is notified by the laboratory sample custodian or Laboratory Manager that the project cannot be accepted. Emergency and enforcement samples are the highest priority for the laboratory. They are always accepted and are prioritized. Routine work is then rescheduled or contracted out.

2.2 Sampling Procedures: Most of the samples processed in this laboratory are collected by private individuals or companies who are responsible for using proper collection procedures. BAL staff will help advise clients on basic sampling protocols and sampling handling procedures. However, ultimately the person or company performing the sampling event is responsible for adherence to correct sampling protocols. Instructions and forms for initiating Chain-of-Custody are available from BAL.

2.2.1 Sampling support is available from BAL when requested by the client, private home owners or consulting firms. If the laboratory is asked to perform a sampling event all proper sampling protocols will be followed starting with initiating the Chain-of-Custody (COC), to preserving the samples properly. The samples will be delivered to the lab in a timely manner and logged into the laboratory information management system (LIMS).

2.2.2 BAL will provide sample containers and all necessary items for sampling and sample handling. If samples are not preserved in the field the laboratory will note this on the COC and perform the proper preservation upon receipt if the samples are still within the acceptable hold times.

2.3 Sample Receipt: Samples are brought into the laboratory receiving area, through the laboratory east entrance. Upon verification of the condition of the samples and the completeness of the chain-of-custody (COC), the Sample Custodian accepts the samples and signs/dates the COC on the samples received line. The Sample Custodian should not allow the client to leave until the COC is completely filled in properly. If the sample custodian is not available the alternate employee should sign the COC.

2.3.1 A sample receipt checklist is completed for each batch of samples that is received. The following information is checked on the COC form:

- project name
- sampler's signature
- sample numbers

- parameters for analysis
- matrix
- number of containers
- relinquished by signature date and time

2.3.2 Proper condition of the samples is checked by measuring the temperature of the cooler, and verification of the following:

- Sample volume sufficient for test
- Appropriate container used for test
- Holding time considerations
- Verification of sample ID on the containers against the sample ID listed on the COC form
- Tests requested are clearly identified

2.3.3 If any deviations are observed the sample custodian notifies the client of the deviations and this is documented on the COC. After the samples are evaluated for correctness as compared to the COC they are logged into the LIMS system, at this point a unique laboratory identification number is generated by the LIMS system (Bridger Analytical identification number). Once the samples have been logged in sample labels are produced and affixed to the correct sample bottles. All associated documentation is placed in the corresponding client folder. The sample custodian prepares all folders and files them according to BAL lab ID number.

2.3.4 The samples are then stored in the appropriate storage refrigerator awaiting analysis:

- Lab Line Ambi-Hi-Lo Chamber (incubator/refrigerator) for Inorganic and general chemistries
- Microbiological samples are analyzed the same day (no storage required)

2.4 Internal Sample Custody:

2.4.1 Internal sample tracking: When preparing to analyze samples, the analyst creates a work list utilizing the LIMS system. When the analyst is ready to remove the samples for analysis he/she must log them out in the appropriate logbook. After analysis, the remainder of the sample is returned to the sample storage refrigerators and the analyst once again records that the samples are returned in the appropriate logbook. After the sample holding time expires, the sample custodian arranges for sample disposal.

2.5 Laboratory Analyses and Monitoring: The progress of the analytical work is accomplished through the LIMS system. Analysts must update the LIMS field daily, or as soon as the next available status is reached.

2.5.1 Available status fields and definition:

- Work in Progress (WIP): Instrumental analysis in progress
- Analysis Complete: Instrumental analysis completed and data entered
- Review Complete: Results calculated and review completed
- Reported: Final report created
- Invoiced: Final report and invoice sent to client

2.5.2 A work in progress report (WIP) can be generated from the LIMS database at any time, showing the status of a particular group of samples. The report includes project number, sample batch, requested parameters and due date.

2.6 External chain-of-custody: Samples sent to an outside analytical laboratory for analysis, are accompanied by, at a minimum, an external COC form.

2.7 Sample Disposal: Sample disposal and waste management is done in accordance with all applicable federal, state, and local regulations. If samples can not be disposed of internally a private certified vendor will be employed to remove the samples.

3 Training Procedures

3.1 New Staff Orientation: All new employees are instructed in the laboratory quality control program and philosophy. New analysts and staff members are required to read the QA manual prior to any activity in the laboratory.

3.1.1 All new laboratory analysts and/or staff are introduced to the administrative practices of the laboratory and the LIMS system. All personnel receive laboratory safety training.

3.2 Technical Training: New analysts are trained in analytical methods and laboratory procedures by senior staff. The process begins with reading the test specific SOPs and observing the procedures as they are performed by an experienced analyst. Depending on the experience of the new analyst, the next training phase can be performed by the new analyst under supervision of the senior analyst, or perform the test independently with peer review of the final data.

3.2.1 Training for new instrumentation or new methodologies is usually done in cooperation with instrument suppliers (on or off-site training or courses).

3.3 Training Records: Individual training records for each employee are maintained in the personnel files of the employee. The QA officer is responsible for maintaining these files.

3.4 Analytical Procedures: Standard Operating Procedures (SOPs) are available for all analyses. The SOP contains detailed instructions about the use and the expected performance of the method. The SOP includes references to applicable standard method(s) and to the applicable QA/QC procedures. If appropriate, deviations from published methodology are documented and explained in the SOPs. SOPs and method references are summarized in Appendix C.

4 Analytical Standards Requirements

4.1 Preparation, preservation and storage of standards: Standards for spiking or calibration purposes are prepared by the analysts using commercially available concentrates of documented purity. Preparation procedures are documented in the analytical logbooks.

4.1.1 Standards are stored in refrigerators, freezers, or at room temperature, according to their nature. Storage of standards is addressed in the method SOPs.

4.2 Standard logbooks: Traceability of the quality and integrity of the prepared standards is accomplished by recording all information related to its preparation in a page numbered logbook. All prepared standards are given a unique laboratory identifier and that number is recorded onto bench sheets or extraction logbooks. This ensures the traceability of standards to the analytical data for that particular batch of samples.

4.3 Expiration dates: Standard expiration dates are generally specified by manufacturer for the stock standard. Intermediate or secondary standard expiration dates are generally given the same expiration date as the stock solution when stored at the appropriate temperatures as defined on the standard certification documentation.

4.3.1 Working standards are generally made from the intermediate standards and are prepared on the same day as the analysis is performed. (This can vary depending on the method SOP).

4.3.2 Labeling of standards: Laboratory standards are labeled with the following information:

- Description/identification of analytes, elements or name if mixed standard.
- Concentration(s)
- Standard type (stock, primary or secondary dilution, working, or calibration).
- Preparation date.
- Expiration date.
- Preparer's initials.

5 Laboratory Documentation

5.1 SOPs: All laboratory SOPs are approved by the QA Officer and the Laboratory Manager before being implemented. The distribution of current SOPs and archiving of outdated ones is controlled by the QA Officer. SOPs must be reviewed annually to insure accuracy and completeness. This review is initiated by the QA officer informing the primary user or author that a review is necessary. If no changes are made by the primary user then the original document is retained and a master update sheet is updated as reviewed with the date of review included. If changes are made to the SOP the document revision number is changed and final review is done by the QA officer. The master sheet is updated in the revision field with the new date. The QA Officer periodically reviews the integrity of the SOPs.

5.1.1 The QA Officer maintains the original copies of the SOPs.

5.2 LIMS: The laboratory relies on a customized Laboratory Information Management System for sample tracking and Work in Progress status. The LIMS generates unique laboratory identification and tracks a large amount of information tied to each sample. The LIMS is essential in maintaining and producing quality data.

5.3 Laboratory Bench Sheets and Notebooks: Laboratory bench sheets are used to document information from routine laboratory operations, including sample preparation and analysis parameters. Analysts are responsible for completing the bench sheets when performing the work. All bench sheets include the following information at a minimum:

- Sample number(s)
- Method name or number
- Date of preparation
- Analysis result
- Analyst(s) initials
- Any notes or comments
- Lot # of reagents
- QCS/LCS ID

5.4 Control Charting: The laboratory uses control charts to visually track precision and accuracy data. These control charts are used to identify trends in the analyses which may indicate a problem with the analytical procedure. When an adverse trend is detected, analyses are stopped and corrective action undertaken. The LCS/QCS is used for methods that can not be spiked with a known amount.

5.4.1 If a method calls for either a Laboratory Fortified Blank (LFB) or matrix spike/matrix spike duplicate (MS/MSD) analysis, Control charts will be produced. Reagent Blanks (RB) can also be charted and should always be less than the reporting limit (RL) for the compound of interest.

5.5 Project Folders: Project folders when complete should contain:

- A copy of the chain-of-custody form.
- A project form generated from LIMS (With sample and Analysis information).
- Applicable bench sheets.
- All raw data from the analysis.
- A copy of the final report.
- Any other documents associated with the analysis (such as a copy of corrective action requests and correspondence with the client.

5.5.1 When the analyses for a project are complete and the final report has been released, all projects folders are inventoried and archived by the sample custodian.

5.6 Archiving and Document Retention: Procedures for archiving of laboratory documents, reports, raw data and, electronic data are listed in the SOP for archiving and document retention (SOP-QA-006-00).

5.7 General Procedures: Good Laboratory Practice Procedures (GLP). Analysts sign and date all bench sheets. Reviews as well as any corrections are also signed and dated; corrections are crossed out using a single line.

6 Quality Control Procedures

6.1 Calibration: Calibration of all instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method.

6.1.1 The frequency of calibration and the concentration of the calibration standards are determined the analytical method.

6.1.2 A brief summary of general calibration procedures follows. Detailed procedures and acceptance criteria are included in the applicable SOPs.

6.1.3 The linearity of the instrument is then determined by performing a calibration for all target compounds using an initial multipoint calibration. The linearity is checked by a continuing one-point calibration. Linearity and acceptance criteria are established using response factor criteria.

6.1.4 Each day, prior to analysis, each chromatographic system is calibrated using either an initial multipoint or a continuing one-point calibration (based on individual method criteria). Linearity and acceptance criteria are established using linear regression statistics.

6.1.5 Calibration standards and acceptance criteria vary depending on the type of the system and on the analytical methodology required for a specific analysis. For example, calibration frequency and criteria for qualitative or semi-quantitative identification analyses are less comprehensive than for quantitative analyses.

6.1.6 These analyses include a variety of instrumental and wet chemical techniques. Each system is calibrated prior to the analyses being

conducted following calibration requirements in the methods (refer to applicable SOPs). At a minimum, at the beginning of each day on which samples are analyzed, a calibration curve covering the sample concentration range and all target analytes is analyzed. The curve is composed of at least five concentrations and a blank.

6.1.7 Electrochemical measurements such as pH and conductivity methods are also made on instruments which have been properly calibrated as specified in the method or instrument manual and checked daily.

6.2 Method Blank or Laboratory Reagent Blank: The method blank is a sample sized portion of deionized, distilled water or clean artificial sand or soil to which all analysis reagents are added. This blank is processed and analyzed like a field sample. The results of the blank are used to check for target compound contamination during sample preparation, or background interference from reagents. A method blank is processed with every batch of samples processed.

6.2.1 Calibration Blanks: The calibration blank is a portion of solvent or the instrument specific background matrix which has not been processed as a sample, but is used to assess instrument contamination, and establish the "zero" calibration point. It is run at a method specified frequency during the analyses. Calibration blanks are applicable for inorganic analyses.

6.2.2 Field Blanks: Field blanks (trip blanks and equipment blanks) are check samples that monitor contamination originating from the collection, transport or storage of environmental samples. A trip blank or field reagent blank is a sample vial of reagent water that accompanies sample containers to the field and shipment. Generally, trip blanks apply to a specific program and in written into the Quality Assurance Project Plan (QAPP) prior to sampling. For general sampling most field sampling will not contain a field blank.

6.3 Blank Policy: Criteria for determining blank acceptability are based on consideration of the analytical techniques used, reported analytes, and required reporting limits. Ideally, the concentration of target analytes in the blank should be below the reporting limit for that analyte. In practice, however, some common laboratory solvents and metals are difficult to eliminate to the ppb levels commonly reported in environmental analyses. The method SOPs address the blank acceptance criteria. If the blank does not meet acceptance criteria, the source of contamination must be investigated and appropriate corrective action taken and documented. Samples associated with a contaminated blank must be re-extracted and reanalyzed if enough sample is available and re-extraction can be done

within holding time. Otherwise, the project manager is notified and if no re-sampling is done, target compounds associated with contamination are flagged in the report. Blank correction of the final data is never permitted or done.

6.4 Laboratory Sample Duplicates: Laboratory sample duplicates are two equal portions of a homogenized field sample which are processed and analyzed simultaneously to assess laboratory precision. A Relative Percent Difference (RPD) is calculated to assess the precision.

6.5 Matrix Spikes: A matrix spike (MS) and a matrix spike duplicate (MSD) are aliquots of a field sample to which known amounts of analytes have been added. The MS/MSD samples are taken through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery and RPD. The MS/MSD analyses are used to evaluate the effect of the sample matrix on the precision and accuracy of the analysis.

6.5.1 If not enough sample is available for an MS/MSD analysis, laboratory Fortified Blanks are done in their place.

6.5.2 Trends in matrix spike recoveries are followed using control charts.

6.6 Laboratory Fortified Blanks: An aqueous Laboratory Fortified Blank (LFB), spiked with known amounts of all analytes, is analyzed for each batch of water samples.

6.7 QC check samples/Laboratory Control Samples (LCS): The laboratory routinely analyzes QC check samples from an outside source to monitor the accuracy of the method.

6.8 Definitions and formulas

6.8.1 Precision is the degree to which the measurement is reproducible. Precision can be assessed by replicate measurements of laboratory control samples, spiked samples, reference materials or environmental samples. The most commonly used estimates of precision are the relative standard deviation or the coefficient of variation (CV).

6.8.2 Accuracy is a determination of how close the measurement is to the true value. Accuracy can be assessed using laboratory control samples, standard reference materials or spiked environmental samples (matrix spike compounds). Accuracy is generally calculated in terms of percent recovery.

6.8.3 Method Detection Limit (MDL): The MDL is defined as the minimum concentration of a substance that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. The laboratory routinely determines MDLs. At a minimum, MDLs are generated and documented upon adoption of a new method.

6.8.3.1 To calculate the MDLs, seven replicate samples are spiked with analytes at concentrations 2-5 times the expected instrument detection limit. These samples are extracted and analyzed for each matrix. All method detection limit study results are reviewed by the QA Officer. Records are kept and maintained in the laboratory QA Office.

6.9 Internal Quality Control Checks: Reagents, solvents and blank media are checked for method contaminants as needed. In general by using a Reagent Blank with each analysis this requirement is met on a daily basis. However the high purity water used in the laboratory will be analyzed as a sample on a monthly basis. The water samples will be taken from the DI water taps throughout the laboratory and analyzed for all compounds currently being reported by BAL. These analyses will be kept on file by the QA officer.

7 Data Reduction, Reporting and Internal Verification

7.1 All analytical data generated within the laboratory are extensively checked for accuracy and completeness.

7.1.1 Data Reduction: The analyst who generates the analytical data has the prime responsibility for correctness and completeness of the data. All data are generated and reduced following protocols specified in the laboratory methods and/or related SOPs.

7.1.2 Data Reporting: BAL reports contain the following:

- Report date,
- Sample and Laboratory ID
- analyst(s) performing the analysis
- analytical procedures (method reference)
- date(s) sample received and analysis date
- Reporting Limit
- Maximum Contaminant Level (MCL when applicable)

7.1.3 QC information: QC information is only reported to the client upon request. All QC information for an analytical batch is stored and filed by date and analysis. The data is reviewed with the applicable data set and checked for completeness/accuracy/precision.

7.1.4 Data Review Process:

1. Primary Review by analyst

- Calculations'
- Identifications of correct analyte
- Completeness
- Sample Identification
- Sample Preservation
- Clean-up Procedures
- QC Data Verification vs. Acceptance Criteria

2. Peer Review

- Calculations
- Sample Identifications
- QC Data Verification vs. Acceptance Criteria
- Possible miss identification of analytes Interferences
- Units
- Documentation

7.2 Performance System Audits

7.2.1 On-site Laboratory Systems Audits: Informal internal systems audits will be performed by the Laboratory Manager and the QA Officer to review laboratory operations to verify that procedures are in place to generate acceptable data. These include, but are not limited to verification of internal chain-of-custody procedures, team workloads, reports integrity, electronically archived data integrity, and adherence to SOPs. Results of these operational audits are documented and discussed in meetings, and if appropriate, procedural changes are implemented. There is no fixed schedule for additional internal audits by the QA Officer. This procedure will happen on a more frequent basis as BAL grows in size and new employees are hired to perform daily procedures in the laboratory. These informal audits will be placed into employee training records. Participation in PT studies to meet certification requirements for work done under the semi-annually. All analytes under certification will be analyzed during the PT studies.

7.3 Corrective Action Policy and Procedures

7.3.1 Corrective actions are necessary when errors, deficiencies, or out-of-control situations exist, i.e. when QC data are outside the acceptance windows for precision and accuracy. Some examples are listed below, but are not limited to these items:

- Blanks contain contaminants above acceptable levels.
- LCS samples contain contaminants other than the spiked compounds above acceptable levels.
- Control charts indicate undesirable trends in spike recoveries or the Relative Percent Difference (RPD) between duplicates.
- There are unusual changes in instrument detection limits.
- Instrument performance problems.
- Improvements in procedures.
- Deficiencies are detected during QA audits, either internal or external, or from the results of performance evaluation (PE) samples.
- Inquiries concerning data quality and reports are received from clients.

7.3.2 Corrective action must be initiated by who ever first discovered the deficiency during the analytical or review process. This is done as soon as a deficiency becomes apparent. Alternately, corrective action can also be

initiated by the QA Officer if review or audits show unacceptable performance.

7.3.3 Minor corrective action procedures are often handled at the bench level by the analyst by verification of the COC and LIMS data, reviewing the preparation or extraction procedure for possible errors, checking the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on.

7.3.4 If the problem persists or cannot be identified, the QA Officer must be notified, and a second opinion requested. In the absence of the QA Officer, the problem will be brought to the attention of the Laboratory Manager. Examples are when QC data remain outside acceptance windows after reanalysis of the samples, or when there is significant blank contamination. Sample processing, analysis or report preparation cannot continue until approved by the QA Officer or the Laboratory Manager.

7.3.5 A Corrective Action Request Form is then used to document progress on the investigation of the problem. Once resolved, full documentation of the corrective action procedure is filed in the QA office. A copy of the form is also filed in applicable project folders.

7.3.6 Corrective actions that apply to PT results, deficiencies of QA audits, client requests, and so on, must all be documented on the Corrective Action Request form.

7.3.7 Corrective action documentation is routinely reviewed by the Laboratory Manager.

8 Definition of Terms

8.1 Aliquot: A measured portion of a sample, or solution, taken for sample preparation and/or analysis.

8.2 Analysis date/time: The date and military time of the analysis of the sample.

8.3 Batch: A group of samples, extracts or digestates that are analyzed at the same time and, where applicable,. within the same calibration sequence. An analytical batch excluding quality control samples, is not to exceed 20 samples.

8.4 Holding time: The period of time during which a sample can be stored after collection and preservation without significantly affecting the accuracy of the analysis. For extracts; the period of time after extraction during which an extract can be stored without affecting the accuracy of the analysis.

8.5 Insufficient quantity: When there is not enough volume or weight to perform any of the required operations: sample analysis for extraction, percent moisture, MS/MSD, etc.

8.6 Quality Assurance: A system of activities whose purpose is to provide to the producer or user of a product or a service the assurance that it meets defined standards or quality with a stated level of confidence. This is the total integrated program for assuring the reliability of the data generated in the laboratory.

8.7 Quality Assurance Plan (QAP): A document describing management policies, objectives, principles, and general procedures outlining the techniques by which the laboratory produces data of known and accepted quality.

8.8 Quality Control: The system of activities whose purpose is to control the quality of a product or service so that it meets the needs of the users. This is the routine application of specific, well-documented procedures.

8.9 Laboratory Control Sample (LCS): A quality control sample obtained from a source independent of the other standards.

8.10 Laboratory Information Management System (LIMS): Computerized system for tracking and reporting samples in the laboratory.

8.11 Sample: A portion of material to be analyzed that is contained in single or multiple containers and identified by a unique sample number.

8.12 Sample Acceptance: The point in time at which the laboratory determines that it can proceed with the analytical work. Sample delivery acceptance follows receipt and inspection of the samples and complete definition of analyses required.

8.13 Standard Operating Procedure (SOP): A detailed, written description of a procedure designed to systematize and standardize the performance of the procedure.

8.14 WIP: Work in Progress.

Appendix A
Detailed Description of the Laboratory

Appendix B
Equipment List

Equipment Name	Serial Number
Dionex IC, Model Number ICS-1000	07060761
Dionex Auto sampler	AS40
pH, Conductivity, DO Meter-sensION378	07020C795006
Incubator-VWR Model 1510E	03079707
Microscope-Van Guard 1221CM	010103
Spectrophotometer-HACH DR2800	1203394
365 nm UV Lamp, Idexx WL160	WL160
UV viewing cabinet, Idexx	WCM10
Nalge Pipet Washer/Rinser from Fisher	15-350-95A
Quant Tray Sealer, Idexx	WQTS2X-115
Nuaire Incubator, Model number NU 2500.	56094 AAY
Turbidimeter, Hach Model 2100A	5129
Hach TenSette pipettor	19700-01
Gilson P200 pipettor	E15837K
Gilson P20 pipettor	H19189G
E/MC Ultrasonic Cleaner, Model LP1 HD	3149hd
Laboratory stirrer, Model P.C.-353	06-15-77
Microscope, American optical, 0.7X to 4.2X	AO570
Revco Refrigerator	U18G-345917-XG
Lab Line Ambi-Hi-Lo Chamber (incubator/refrigerator)	7549
Thermofisher iCap RQ ICP-MS	
Mettler Toledo T-7 autotitrator system	
Thermofisher Aquion Ion Chromotography	

Appendix C
SOPs and Method References

Master List of Standard Operating Procedures (SOP)					
SOP #	Title	Type	Revision#	Date Implemented	Status
SOP-QA-002-00	Preparation and Usage of Standard Operating Procedures	QA	1.9	January 2017	In-Progress
SOP-QA-003-00	Deionized Water Monitoring	QA	1.9	January 2017	In-Progress
SOP-QA-004-00	Sample Acceptance and Login	QA	1.9	January 2017	In-Progress
SOP-QA-005-00	Notification Procedures for Samples Above Compliance Limit	QA	1.9	January 2017	In-Progress
SOP-QA-006-00	Processing Sample Results	QA	1.9	January 2017	In-Progress
SOP-QC-001-00	Analysis of Anions by ION Chromatography, EPA 300.1	QC	2.0	May 2020	In-Progress
SOP-QC-002-00	pH by SM 4500-H^+-B	QC	1.9	January 2017	In-Progress
SOP-QC-003-00	Determination of Specific Conductance by SM 2510B	QC	1.9	January 2017	In-Progress
SOP-QC-004-00	Coliform and E. Coli water Analysis by SM 9223B (Colilert and Colisure)	QC	1.9	January 2017	In-Progress
SOP-QC-005-00	Glassware Cleaning	QC	1.9	January 2017	In-Progress
SOP-QC-006-00	Trace Metals ICP-MS via 200.8	QC	2.0	May 2020	In-Progress

Appendix D
Summary of Analysts Qualifications

F. Andrew Frame, Ph.D.
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Highlights:

- Research and development experience with inorganic nanoparticles: synthesis, development, optimization, and characterization using a diverse set of laboratory skills and advanced analytical instrumentation techniques.
- As an analytical chemist, a high degree of sample multi-tasking, responsibility, accuracy, and knowledge of sample priority required daily with every analysis performed.
- Performed chemical and microbiological analyses for public and private drinking water systems in a state-certified water testing lab using EPA and Standard Methods for environmental analyses.
- Advanced analytical chromatography methodologies: GC-MS, GC-FID, GC-TCD, HPLC, LC-MS, and IC
- Advanced analytical spectroscopy and spectrometry instrumentation: AAS, NMR, UV-Vis, FTIR, and fluorescence
- Surface chemistry, physical chemistry, and materials analysis methodologies: TEM, EDX, XPS, UPS, AES, XRD, electrochemistry, and photochemistry
- Multi-discipline research experience with energy storage chemistry, solar energy, inorganic nanoparticles, photocatalysts, and nanomaterial composites.
- Well-developed verbal communication skills as a chemist and higher-education instructor, as demonstrated with daily scientific presentations and engaging academic lectures.
- Successful lab management, instruction, leadership, feedback, and new employee training.
- Promoted a constructive environment for all coworkers of diverse educational and cultural backgrounds.
- Sales experience in the wine industry as a wine steward, with proven customer satisfaction, increased monthly sales, wholesale

sales and distribution, and personalized VIP wine experiences, and wine club management.

Education:

- Department of Chemistry, University of California, Davis, California

Ph.D. in Chemistry, 2006 – 2010

- Southwestern Oklahoma State University, Weatherford, Oklahoma

Bachelor of Science, Chemistry (ACS certified) and Mathematics, 1998 – 2002

Experience:

Analytical Chemist, 2018 (6 months); **Laboratory Director** 2018 – Present **;** **President,** 2020 – Present

Bridger Analytical Lab, Bozeman, Montana

- Performed chemical and microbiological analyses for public and private drinking water, and wastewater systems in a state-certified water testing lab using EPA and Standard Methods for environmental analyses.
- Chemical analyses: Ion Chromatography (IC), pH, solution conductivity, turbidity, hardness, alkalinity, and others.
- Microbiological analyses: Heterotrophic Plate Count (HPC), Total Coliform/*E. coli* Bacteria (Presence/Absence, Counts)
- Responsible for ion chromatography method detection limit (MDL), linear dynamic range, and quality control studies.
- Reported maximum contamination level violations of chemical and microbiological contaminants to the Montana DEQ.
- In charge of lab-to-state (LTS) reporting to DEQ for all public drinking water system samples.
- Supervised all subcontracted lab analysis work (sample receiving, shipping, data input and review).
- Provided technical information and results explanation to customers.
- Sample login and receipt, email completed reports to customers, and many other miscellaneous duties.

Chemistry Instructor, 2013 – 2015

Montana State University, Bozeman, Montana

- As the instructor of record, taught 2-3 lecture sections of general chemistry per semester (about 250 students per section), and also advanced upper-placement chemistry courses during the summer terms.

- Successfully managed 15-25 recitation and lab teaching assistants (with various degree backgrounds) per semester.
- Directed all aspects of chemistry lecture design and presentation, exam preparation, electronic engagement, and undergraduate student assessment.
- Effectively communicated and worked with students and employees of very diverse educational and cultural backgrounds.
- Served and contributed to the departmental committee to evaluate and select future educational materials.
- Frequently consulted with the Center for Faculty Excellence to improve lecture styles and student engagement.

Postdoctoral Researcher, 2011 – 2013
Portland State University, Portland, Oregon

- Designed, executed, and analyzed experiments to meet team research goals and specifications.
- Synthesis, troubleshooting, optimization, and characterization of novel core-shell silicon and inorganic nanomaterials.
- Successful leadership, mentorship, and instruction responsibilities to graduate students and lab technicians.
- Extensive use of electron microscopy, X-ray diffraction, UV-Visible, Infrared, and fluorescence spectroscopy to characterize optical and electronic properties, and structure morphology.
- Writing, editing, and proofreading of manuscripts and proposals by providing both publication quality text and figures.

Senior Chemist Consultant, 2010
Vernier Software and Technology, Beaverton, Oregon

- Performed robust scientific testing, method validation, proofreading, suggested hardware modifications and improvements, and gave creative feedback to improve product performance and reliability on future company instruments and products.

Doctoral Researcher, 2006 – 2010
Department of Chemistry, University of California, Davis, California

- Cross-discipline research of nanomaterials photocatalytically splitting water using sunlight as a hydrogen fuel source.
- Examined inorganic nanoparticle catalyst and co-catalyst syntheses, assembly, and photocatalytic properties.
- Expertize in electron microscopy (TEM) characterizing structure, morphology, and elemental composition (EDX and EELS).
- UV-Visible and fluorescence spectroscopy to characterize optical properties and electronic structure.

- Studied photon flux measurements (irradiance/radiometry) for energy-efficiency calculations.
- Designed, assembled, and calibrated a new chemical reactor (and method) for measuring catalytic hydrogen (and oxygen) evolution from aqueous solutions using UV and visible light sources.
- Extensive use of inert atmosphere chemical synthesis and handling techniques.
- Used AAS, GC/TCD, and other analytical techniques.
- Used ion exchange resins for syntheses and purifications.
- Used dialysis techniques for ion separation and solution conductivity measurements.
- Trained other graduate students on new equipment use, procedures, and safety.
- Managed laboratory while research director was on sabbatical, including personnel, chemical inventory, and safety.
- Prepared and presented research presentations for local group meetings and national ACS meetings.

Analytical Chemist, 2004 – 2006

Boulder Scientific Company, Mead, Colorado

- Analyzed final product samples, and intermediate samples from producing departments.
- Samples included: inorganic catalysts and cocatalysts, organometallics, grignards, organic ligands, and raw materials.
- Accurate and safe analyses of samples that are oxygen-sensitive (reactive), and/or time-sensitive.
- Expertise with GC/FID, GC/MS, LC/MS, FTIR, AAS, 1D-NMR (multinuclear), UV/Vis, DSC, TGA, pH meters, wet-lab chemistry and other techniques.
- Worked effectively under minimal direct supervision as the sole chemist on duty.
- High degree of sample multi-tasking, responsibility, accuracy, and knowledge of sample priority required daily.
- Troubleshoot small to large-scale chemical processes from R&D, Pilot plant, or ton-scale production plant.
- Required knowledge of multiple chemical processes running in production environment.
- Experience with validation of analytical methodology.
- Regular communication/collaboration with multiple departments for analyses, results, specifications and shipping dates.
- Writing and proofreading of GLP/GMP, SOP's, and several daily instrument calibrations, maintenance, and record keeping.
- Trained as ISO 9000 internal audit team member.

Graduate Researcher, 2003

Department of Chemistry, Colorado State University, Fort Collins, Colorado

- Extensive use, knowledge, and regular maintenance of multi-component Ultra-High Vacuum (UHV) surface chemistry: XPS, UPS, AES, and LEED surface analysis techniques, Temperature Programmed Desorption (TPD), Low temperature Scanning Tunneling Microscopy (STM) to examine the electronic and physical interactions of metal surface/semiconductor interfaces.

Graduate Teaching Assistant, 2006 – 2010

Department of Chemistry, University of California, Davis

- Instructed undergraduate labs, recitation, and discussion sessions for many courses of general chemistry.
- Managed student evaluation (writing and grading quizzes/exams) for both graduate and undergraduate classes.
- Communicated technical science effectively to non-science majors.

Computer Technician Assistant, 1998 – 2002

SWOSU Information Technology Services, Weatherford, Oklahoma

- Provided campus-wide software, hardware, and network troubleshooting support for PC's, Apple, and peripherals.
- Communicated technical information effectively to non-technical employees.

Publications, Academic Courses Taught, and Professional Scientific Conference Presentations:

- List available as an appendix and includes peer-reviewed publications and presentations given at national ACS meetings.

Honors & Activities:

- Graduate Student Researcher Award recipient, UC Davis Graduate studies, 2010
- Borge Graduate Research Fellowship recipient, UC Davis Chemistry Department, 2006-2008
- Stuart Burchett Analytical Chemistry Award recipient, SWOSU Chemistry department scholarship, 2000-2001
- Chemistry Club, SWOSU Vice President, 2000-2001
- Castleberry Award, SWOSU Chemistry department scholarship recipient, 1999-2000

DAMION S. LYNN

Contact Details
Address: 3303 Fallon St #2B
Bozeman, MT 59718
Cell: (406)-490-6339
Email: lynn.damions@gmail.com

CAREER HIGHLIGHTS

- 5 years of research and analytical lab experience
- OSHA 10-hour general industry certification
- Received safety certificates including First Aid/CPR

CORE COMPETENCIES

- Highly competent in laboratory operation, management and safety procedures
- Element LIMS, Chromeleon 7, Lab X7, Excel
- Numerous biological and inorganic analyses
- Highly organized and attentive to detail

ACADEMIC BACKGROUND

MONTANA STATE UNIVERSITY -- MAY 2019
Bachelor of Science in Environmental Science

REFERENCES

- Jason Swietek, training technician at Bridger Analytical Lab, (406) 600-3458, jason.swietek.r9@gmail.com
- Dr. Cecilia Peluola, Plant Pathologist at MSU (406) 209-5751, cecilia.peluola@montana.edu
- Nancy Blake, Spring Wheat Research

ABOUT

An analytical chemist at Bridger Analytical Lab, with a bachelors in environmental science from Montana State University. My passion for the environment is coupled with a scientific background to allow for the production of clear, and correct data. I am interested in population studies, GC/MS, and improving my statistical analysis tools.

EXPERIENCE

ANALYTICAL CHEMIST -- (406) 582-0822 -- 43hrs weekly, Tue.-Sat. 8:30am-6pm

Bridger Analytical Lab | Aug. 2020 CURRENT

Conducted analyses on public water systems under EPA methodology
Created and executed commands on Aquion Dionex machines, integrated, and interpreted anion and cation data through the Chromeleon 7 program
Created standards for all equipment within the lab
Ensured the lab passed proficiency tests for each instrument
Generated daily task list for lab technicians

LAB TECHNICIAN -- (406) 582-0822 -- 38hrs weekly, Tue.-Sat. 8:30am-5:30pm

Bridger Analytical Lab | Aug. 2019 _Aug. 2020

Prepared samples for EPA 300.1 and EPA 200.8
Generation and population of clients, work orders, bench sheets, invoices, and reports
Interaction with customers and the DEQ to provide sampling information, pricing, clarification, interpretation of results, and recommendation of solutions

LAB ASSISTANT -- (406) 551-7738 -- 20/40hrs weekly, seasonally Mon.-Fri. schedule varied

MSU Pulse Diagnostic Center | Sept. 2017 _Aug. 2018

Assisted a postdoctoral researcher with research on the fungal parasite *Botrytis*
Responsible for the creation, cleaning, and disposal of various lab chemicals and media, as well as the design of experiments and data recording
Used various lab tools and techniques such as DNA extraction, Koch postulate, hemocytometer, creation of various agars, and preparation of samples for electron microscopy

LAB ASSISTANT -- (406) 994-4899 -- 20/40hrs weekly, seasonally, Mon.-Fri. Schedule varied

Gabriel Bourne

Work Experience

Production Chemist
Bio-Rad Laboratories, Inc. - Woodinville, WA
April 2020 to Present
Using GLP and cGMP, completed reactions and synthesis of needed compounds for the BioPlex 2200. Characterized products using in process testing to ensure product conformity. Accurately followed SOPs.

Operations Associate
Bio-Rad - Woodinville, WA
2020 to Present
Performed filling and labeling using cGMP and following standard operating procedures.Set up and operated machinery. Accurately completed manufacturing batch records and equipment logs.

Graduate Research Assistant
Chemistry Dept., Western Washington University
January 2016 to September 2019
Preformed independent research. Set up and performed experiments; conducted literature searches; synthesized and characterized novel organic and inorganic compounds using a variety of instruments and techniques.

Teaching Assistant, Chemistry Dept
Undergrad Research, Chemistry Dept., Western Washington University
2017 to 2019
Led lab sessions in undergraduate chemistry classes. Presented information and taught key concepts; ensured students followed proper procedures; answered questions; graded papers; enforced safety standards.

Lab Assistant, Chemistry Dept
Undergrad Research, Chemistry Dept., Western Washington University
2015 to 2016
Monitored students performing lab experiments to ensure safety and proper procedures. Set up lab equipment and supplies; answered questions; graded pre-lab papers; enforced safety standards.

Canvasser
Polar Bear Energy Solutions - Mountlake Terrace, WA
2012 to 2015
Went door-to-door signing up homeowners for free estimates. Accurately completed paperwork; staffed sales booth in county fairs; answered questions; overcame objections. Company sales leader for 3 months.

Education

Master's in Chemistry, MS
Western Washington University - Bellingham, WA
September 2017 to June 2019

Bachelor's in Chemistry
Western Washington University - Bellingham, WA
September 2012 to June 2017

Appendix C
Focused Feasibility Study ARARs

For Administrative Settlement Agreement and Order on Consent
for In Situ Amendments in Support of Focused Feasibility Study
Idaho Pole Company Superfund Site
Bozeman, Montana

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) Idaho Pole Company Focused Feasibility Study			
Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
PAGE MARKER: CHEMICAL SPECIFIC REQUIREMENT Chemical-specific ARARs are usually health-or risk-based numerical values or methodologies used to determine acceptable concentrations of chemicals that may be found in or discharged to the environment			
Statute | Water Quality			
Presence of on-site chemical(s) that may be found in or discharged to the environment	Section 75-5-308, MCA *Available at*: https://leg.mt.gov/BILLS/mca/title_0750/chapter_0050/part_0030/section_0080/0750-0050-0030-0080.html TITLE 75. ENVIRONMENTAL PROTECTION CHAPTER 5. WATER QUALITY Part 3. Classification and Standards Short-Term Water Authorizations -- Water Quality Standards **75-5-308. Short-term water authorizations -- water quality standards.** (1) Because these activities promote the public interest, the department may, if necessary, authorize short-term exemptions from the water quality standards for the following activities: (a) emergency remediation activities that have been approved, authorized, or required by the department; and (b) application of a pesticide that is registered by the United States environmental protection agency pursuant to 7 U.S.C. 136(a) when it is used to control nuisance aquatic organisms or to eliminate undesirable and nonnative aquatic species. (2) An authorization must include conditions that minimize, to the extent practicable, the magnitude of any change in the concentration of the parameters affected by the activity and the length of time during which any change may occur. The authorization must also include conditions that prevent significant risk to public health and that ensure that existing and designated uses of state water are protected and maintained upon completion of the activity. Authorizations issued under this section may	☑Applicable* *Applicable to remedial actions that may have short-term impacts (such as spikes in groundwater concentrations when using in situ enhancements) on water quality if DEQ determines the activities meet certain criteria.	Allows DEQ to grant short-term exemptions from the water quality standards for the purpose of allowing certain emergency environmental remediation activities

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
Idaho Pole Company Focused Feasibility Study

<table>
<tr><th>Site-Specific Characteristics</th><th>Citation(s)</th><th>Prerequisite</th><th>Requirements</th></tr>
<tr><td></td><td>include conditions that require water quality or quantity monitoring and reporting. In the performance of its responsibilities under this section, the department may negotiate operating agreements with other departments of state government that are intended to minimize duplication in review of activities eligible for authorizations under this section.
(3) An authorization to use a pesticide does not relieve a person from the duty to comply with Title 80, chapters 8 and 15. The department may not authorize an exemption from water quality standards for an activity that requires a discharge permit under rules adopted by the board pursuant to 75-5-401.</td><td></td><td></td></tr>
<tr><td>Statute | Public Water Supply</td><td></td><td></td><td></td></tr>
<tr><td>Presence of on-site chemical(s) that may be found in or discharged to public water supply</td><td>40 C.F.R. § 141.61 Subpart G National Primary Drinking Water Standards -Maximum Contaminant Levels
Available at:
https://www.epa.gov/sites/production/files/2015-09/documents/cfr-2014-title40-vol23-sec141-62_0.pdf

§ 141.61 Maximum contaminant levels for organic contaminants.
(a) [Reserved]

(b) The Administrator, pursuant to section 1412 of the Act, hereby identifies granular activated carbon (GAC), packed tower aeration (PTA), or oxidation (OX) as the best technology treatment technique, or other means available for achieving compliance with the maximum contaminant levels for benzo(a)pyrene, pentachlorophenol, and 2,3,7,8-TCDD (Dioxin)identified in paragraph (c) of this section:

(c) The maximum contaminant levels for organic contaminants specified in paragraphs (c)(16), (c)(19) and (c)(33), of this section apply to community water systems and non-transient, non-community water systems.

<table><tr><th>Constituent</th><th>MCL (expressed as milligrams per liter)</th></tr><tr><td>Benzo(a)pyrene</td><td>0.2</td></tr><tr><td>Pentachlorophenol</td><td>1.0</td></tr><tr><td>2,3,7,8-TCDD (Dioxin</td><td>3×10^{-5}</td></tr></table></td><td>☑Relevant and Appropriate

Only three of the site contaminants have federal MCLs</td><td></td></tr>
<tr><td>Regulation | Surface Waters</td><td></td><td></td><td></td></tr>
<tr><td>Presence of on-site chemical(s) that may be found in or discharged to state waters</td><td>ARM 17.30.705
Available at:
http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E30%2E705

Rule Title: BIOASSAYS
Department: Environmental Quality
Chapter: Water Quality
Subchapter: Nondegradation of Water Quality</td><td>☑Applicable

* This refers to the non degradation policy. Part of the purpose of the groundwater remedy is to prevent impacts of contaminated</td><td>Provides that for any surface water, existing and anticipated uses and the water quality necessary to protect these uses must be maintained and protected unless degradation is allowed under the non-</td></tr>
</table>

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) Idaho Pole Company Focused Feasibility Study			
Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
		groundwater to surface water, as well as any impacts from remedial construction to impact surface water. The non degradation requirements in statute and regulation apply to all state waters (see 17.30.705(2)(a).	degradation rules at ARM 17.30.708
Presence of on-site chemical(s) that may be found in or discharged to specific water body at Site	ARM 17.30.610 *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=17.30.608 Rule Title: WATER-USE CLASSIFICATIONS—MISSOURI RIVER DRAINAGE EXCEPT YELLOWSTONE, BELLE FOURCHE, AND LITTLE MISSOURI DRAINAGES Department: Environmental Quality Chapter: Water Quality Subchapter: Surface Water Quality Standards and Procedures **17.30.610** WATER-USE CLASSIFICATIONS—MISSOURI RIVER DRAINAGE, EXCEPT YELLOWSTONE, BELLE FOURCHE, AND LITTLE MISSOURI DRAINAGES (1) The water-use classifications adopted for the Missouri River are as follows: (a) Missouri River drainage to and including the Sun River drainage except tributaries listed in (1)(a)(i) through (xiii) B-1 (i) East Gallatin River (mainstem) from Montana Highway No. 411 (Spring Hill Road, approximately at latitude 45.7256, longitude -111.0666) crossing to Dry Creek about five miles east of Manhattan B-2	☑Applicable* *This ARM pertains to meeting the proposed PRAO, which states: *"Ensure there are not groundwater impacts to surface water above DEQ-7 standards or MCLs and/or receptors beyond the boundary of the CGA"*	Comply with B-1 water-use classification for Missouri River drainage Except Yellowstone, Belle Fourche, and Little Missouri Drainages; ARM 17.30.623 codifies the B-1 water-use classification standards. This section provides the beneficial uses for the B-1 classification, and provides that concentrations of toxic, carcinogenic, or harmful parameters of the waters may not exceed DEQ-7 standards. This section also provides the specific water quality standards for water classified as B-1.
	17.30.623 B-1 CLASSIFICATION STANDARDS (1) Waters classified B-1 are to be maintained suitable for drinking, culinary, and food processing purposes, after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply. (2) No person may violate the following specific water quality standards for waters classified B-1:	☑Applicable* *This ARM pertains to meeting the proposed PRAO, which states:	Referenced in ARM 17.30.610

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) Idaho Pole Company Focused Feasibility Study			
Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	(a) Water quality criteria for Escherichia coli are expressed in colony forming units per 100 milliliters of water or as most probable number, which is a statistical representation of the number of organisms in a sample, as incorporated by reference in 40 CFR 136.3(b). The water quality standard for Escherichia coli bacteria (E-coli) varies according to season, as follows: (i) from April 1 through October 31, the geometric mean number of E-coli may not exceed 126 colony forming units per 100 milliliters and 10 percent of the total samples may not exceed 252 colony forming units per 100 milliliters during any 30-day period; and (ii) from November 1 through March 31, the geometric mean number of E-coli may not exceed 630 colony forming units per 100 milliliters and 10 percent of the samples may not exceed 1,260 colony forming units per 100 milliliters during any 30-day period. (b) Dissolved oxygen concentration must not be reduced below the applicable standards given in department Circular DEQ-7. (c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0. (d) The maximum allowable increase above naturally occurring turbidity is five nephelometric turbidity units except as permitted in 75-5-318, MCA. (e) A 1ºF maximum increase above naturally occurring water temperature is allowed within the range of 32ºF to 66ºF; within the naturally occurring range of 66ºF to 66.5ºF, no discharge is allowed which will cause the water temperature to exceed 67ºF; and where the naturally occurring water temperature is 66.5ºF or greater, the maximum allowable increase in water temperature is 0.5ºF. A 2ºF per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55ºF. A 2ºF maximum decrease below naturally occurring water temperature is allowed within the range of 55ºF to 32ºF. This applies to all waters in the state classified B-1 except for Prickly Pear Creek from McClellan Creek to the Montana Highway No. 433 crossing where a 2ºF maximum increase above naturally occurring water temperature is allowed within the range of 32ºF to 65ºF; within the naturally occurring range of 65ºF to 66.5ºF, no discharge is allowed which will cause the water temperature to exceed 67ºF; and where the naturally occurring water temperature is 66.5ºF or greater, the maximum allowable increase in water temperature is 0.5ºF. (f) No increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except as permitted in 75-5-318, MCA), settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife. (g) True color must not be increased more than five color units above naturally occurring color. (h) Concentrations of carcinogenic, bioconcentrating, toxic, radioactive, nutrient, or harmful parameters may not exceed the applicable standards set forth in Department Circular DEQ-7 and, unless a nutrient standards variance has been granted, Department Circular DEQ-12A. (i) Dischargers issued permits under ARM Title 17, chapter 30, subchapter 13, shall conform with ARM Title 17, chapter 30, subchapter 7, the nondegradation rules, and may not cause receiving water	*"Ensure there are not groundwater impacts to surface water above DEQ-7 standards or MCLs and/or receptors beyond the boundary of the CGA"* Monitoring of compliance wells in proximity to Rocky Creek will ensure compliance with the PRAO	

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
Idaho Pole Company Focused Feasibility Study

Site-Specific Characteristics	Citation(s)	Prerequisite	Requirements
	concentrations to exceed the applicable standards specified in Department Circular DEQ-7 and, unless a nutrient standards variance has been granted, Department Circular DEQ-12A when stream flows equal or exceed the design flows specified in ARM 17.30.635(2). (j) If site-specific criteria for aquatic life are adopted using the procedures given in 75-5-310, MCA, the criteria shall be used as water quality standards for the affected waters and as the basis for permit limits instead of the applicable standards in Department Circular DEQ-7. (k) In accordance with 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water as long as the minimum treatment requirements, adopted pursuant to 75-5-305, MCA, are met.		
Presence of on-site chemical(s) that may be found in or discharged to surface water	ARM 17.30.637 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E30%2E637 Rule Title: GENERAL PROHIBITIONS Department: Environmental Quality Chapter: Water Quality Subchapter: Surface Water Quality Standards and Procedures ARM **17.30.637** GENERAL PROHIBITIONS (1) State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will: (a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines; (b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter), or globules of grease or other floating materials; (c) produce odors, colors, or other conditions as to which create a nuisance or render undesirable tastes to fish flesh or make fish inedible; (d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant, or aquatic life; and (e) create conditions which produce undesirable aquatic life. (2) No wastes may be discharged and no activities conducted such that the wastes or activities, either alone or in combination with other wastes or activities, will violate, or can reasonably be expected to violate, any of the standards. (3) Until such time as minimum stream flows are established for dewatered streams, the minimum treatment requirements for discharges to dewatered receiving streams must be no less than the minimum treatment requirements set forth in ARM 17.30.1203. (4) Treatment requirements for discharges to ephemeral streams must be no less than the minimum treatment requirements set forth in ARM 17.30.1203. Ephemeral streams are subject to ARM 17.30.635 through 17.30.637, 17.30.640, 17.30.641, 17.30.645, and 17.30.646 but not to the specific water quality standards of ARM 17.30.620 through 17.30.629. (5) Pollution resulting from storm drainage, storm sewer discharges, and non-point sources, including irrigation practices, road building, construction, logging practices, over-grazing, and other practices must be eliminated or minimized as ordered by the department. (6) Application of pesticides in or adjacent to state surface waters must be in compliance with the labeled direction, and in accordance with provisions of the Montana Pesticides Act (Title 80, chapter 8, MCA) and the Federal Environmental Pesticides Control Act (7 USC 136, et seq., (Supp. 1973) as amended). Excess pesticides and pesticide containers must not be disposed of in a manner or in a location where they are likely to pollute surface waters. (7) No pollutants may be discharged and no activities may be conducted which, either alone or in combination with other wastes or activities, result in the total dissolved gas pressure relative to the water surface exceeding 110% of saturation.	☑Applicable This is consistent with the proposed PRAO, which states: *"Ensure there are not groundwater impacts to surface water above DEQ-7 standards or MCLs and/or receptors beyond the boundary of the CGA"* Monitoring of compliance wells in proximity to Rocky Creek will ensure compliance with the PRAO	Prohibits certain unpermitted discharges

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) Idaho Pole Company Focused Feasibility Study			
Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
Presence of on-site chemical(s) that may be found in or discharged to state waters, triggering sampling and analysis requirements	ARM 17.30.641 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E30%2E641 Rule Title: SAMPLING METHODS Department: Environmental Quality Chapter: Water Quality Subchapter: Surface Water Quality Standards and Procedures ARM **17.30.641** SAMPLING METHODS (1) Water quality monitoring, including methods of sample collection, preservation, and analysis used to determine compliance with the standards must be in accordance with 40 CFR Part 136 (July 1, 2015) or other method allowed by the department.	☑Applicable* *This is consistent with the proposed PRAO, which states: *"Ensure there are not groundwater impacts to surface water above DEQ-7 standards or MCLs and/or receptors beyond the boundary of the CGA"* * No surface water samples are collected at the Site. Monitoring of compliance wells in proximity to Rocky Creek will ensure compliance with the PRAO	Provides standards for sampling and analysis of water to determine quality
Presence of on-site chemical(s) that may be found in or discharged to ground water	ARM 17.30.1006(1) *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=17.30.1006 Rule Title: CLASSIFICATIONS, BENEFICIAL USES, AND SPECIFIC STANDARDS FOR GROUND WATERS Department: Environmental Quality Chapter: Water Quality Subchapter: Montana Ground Water Control System 17.30.1006 CLASSIFICATIONS, BENEFICIAL USES, AND SPECIFIC STANDARDS FOR GROUND WATERS (1) Class I ground waters are those ground waters with a natural specific conductance less than or equal to 1,000 microSiemens/cm at 25ºC. (a) The quality of Class I ground water must be maintained so that these waters are suitable for the following beneficial uses with little or no treatment: (i) public and private water supplies; (ii) culinary and food processing purposes; (iii) irrigation;	☑Applicable Groundwater at the Site has a Class 1 designation	

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
Idaho Pole Company Focused Feasibility Study

<table>
<tr><th>Site-Specific Characteristics</th><th>Citation(s)</th><th>Prerequisite</th><th>Requirements</th></tr>
<tr><td></td><td>(iv) drinking water for livestock and wildlife; and
(v) commercial and industrial purposes.
(b) Except as provided in ARM 17.30.1005(2) , a person may not cause a violation of the following specific water quality standards in Class I ground water:
(i) the human health standards for ground water listed in DEQ-7;
(ii) for concentrations of parameters for which human health standards are not listed in DEQ-7, no increase of a parameter to a level that renders the waters harmful, detrimental, or injurious to the beneficial uses listed for Class I water. The department may use any pertinent credible information to determine these levels; and
(iii) no increase of a parameter that causes a violation of the nondegradation provisions of 75-5-303 , MCA.</td><td></td><td></td></tr>
<tr><td>Presence of chemical or metal in ground waters or surface waters</td><td>Montana Circular DEQ-7
Available at:
DEQ-7.pdf (mt.gov)
Montana Numeric Water Quality Standards

<table>
<tr><th>Constituent</th><th>Page Reference</th><th>Human Health Standard Groundwater (Micrograms/Liter)</th></tr>
<tr><td>Pentachlorophenol</td><td>60</td><td>1.0</td></tr>
<tr><td>Trichlorophenoal</td><td>70</td><td>300</td></tr>
<tr><td>Dichlorophenol</td><td>30</td><td>10</td></tr>
<tr><td>Chlorophenol</td><td>21</td><td>30</td></tr>
<tr><td>B2 PAHs (carcinogenic)</td><td></td><td></td></tr>
<tr><td>Benzo(a)pyrene</td><td>13</td><td>0.05</td></tr>
<tr><td>Benz(a)anthracene</td><td>14</td><td>0.5</td></tr>
<tr><td>Benzo(b)fluoranthene</td><td>14</td><td>0.5</td></tr>
<tr><td>Benzo(k)fluoranthene</td><td>14</td><td>5</td></tr>
<tr><td>Chrysene</td><td>22</td><td>50</td></tr>
<tr><td>Dibenz(a,h)anthracene</td><td>26</td><td>0.05</td></tr>
<tr><td>Indeno(1,2,3-CD) pyrene</td><td>46</td><td>0.5</td></tr>
<tr><td>Total D PAHs (non-carcinogenic)</td><td></td><td></td></tr>
<tr><td>Acenaphthylene</td><td>7</td><td>70</td></tr>
<tr><td>Acenaphthene</td><td>7</td><td>70</td></tr>
<tr><td>Naphthalene</td><td>52</td><td>100</td></tr>
<tr><td>Fluorene</td><td>40</td><td>50</td></tr>
<tr><td>Phenanthrene</td><td>61</td><td>-</td></tr>
<tr><td>Anthracene</td><td>11</td><td>2100</td></tr>
<tr><td>Fluoranthene</td><td>40</td><td>20</td></tr>
<tr><td>Pyrene</td><td>63</td><td>20</td></tr>
<tr><td>Benzo(g,h,i)perylene</td><td>13</td><td>-</td></tr>
<tr><td>2,3,7,8-TCDD (Dioxin)</td><td>36</td><td>2.0×10^{-6}</td></tr>
</table>
</td><td>☑Applicable

Note: DEQ-7 human health standards for the primary contaminants of concern in groundwater are listed. Compliance with all DEQ-7 standards is required and remedial actions must meet the DEQ-7 standards for all contaminants at the facility, including any breakdown products generated during remedial actions.</td><td></td></tr>
</table>

PAGE MARKER: LOCATION SPECIFIC REQUIREMENT

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
Idaho Pole Company Focused Feasibility Study

Site-Specific Characteristics	Citation(s)	Prerequisite	Requirements
Location-specific requirements are restrictions place on the concentration of hazardous substances or the conduct of activities solely because they occur in special locations.			
Statute | Fish & Wildlife			
	Section 87-5-107(3), MCA *Available at*: https://leg.mt.gov/bills/mca/title_0870/chapter_0050/part_0010/section_0070/0870-0050-0010-0070.html TITLE 87. FISH AND WILDLIFE CHAPTER 5. WILDLIFE PROTECTION Part 1. Nongame and Endangered Species List Of Endangered Species **87-5-107. List of endangered species.** (1) (a) On the basis of investigations on nongame wildlife provided for in **87-5-104** and other available scientific and commercial data and after consultation with other state wildlife agencies, appropriate federal agencies, and other interested persons and organizations, the department shall recommend to the legislature a list of those species and subspecies of wildlife indigenous to the state that are determined to be endangered within this state, giving their common and scientific names by species and subspecies. (b) The department may propose legislation to specifically include any species or subspecies of fish and wildlife appearing on the United States' list of endangered native fish and wildlife (part 17 of Title 50 of the Code of Federal Regulations, appendix D) as it appears on July 1, 1973, as well as any species or subspecies of fish and wildlife appearing on the United States' list of endangered foreign fish and wildlife (part 17 of Title 50 of the Code of Federal Regulations, appendix A), as that list may be modified. (2) (a) The department shall conduct a review of the state list of endangered species every 2 years. The department may propose specific legislation to amend the list by additions that are considered appropriate and at times that are considered appropriate. (b) Whenever a species or subspecies is removed from the United States' list of endangered native fish and wildlife (part 17 of Title 50 of the Code of Federal Regulations, appendix D) and that species or subspecies is also on the state list of endangered species in ARM 12.5.201, the department shall amend the state list to remove that species or subspecies. The removal of a species or subspecies from the state list pursuant to this subsection (2)(b) does not require approval by the legislature. (3) Except as otherwise provided in this part, it is unlawful for any person to take, possess, transport, export, sell, or offer for sale and for any common or contract carrier knowingly to transport or receive for shipment any species or subspecies of wildlife appearing on any of the following lists: (a) the list of wildlife indigenous to the state determined to be endangered within the state pursuant to subsection (1); (b) any species or subspecies of fish and wildlife included by the department and appearing on the United States' list of endangered native fish and wildlife (part 17 of Title 50, Code of Federal Regulations, appendix D) as it appears on July 1, 1973; and the United States' list of endangered foreign fish and wildlife (part 17 of Title 50, Code of Federal Regulations, appendix A), as that list may be modified. (4) Any species or subspecies of fish and wildlife appearing on any of the enumerated lists that is brought into the state from another state or from a point outside the territorial limits of the United States and that is transported across the state destined for a point beyond the state may be brought into the state and transported without restriction in accordance with the terms of any federal permit or permit issued under the laws or regulations of another state. (5) If the United States' list of endangered native fish and wildlife is modified by additions, the modifications, whether or not involving species or subspecies indigenous to the state, may be accepted as binding under subsections (3) and (4) if, after the type of scientific determination described in subsection (1), the department proposes and the legislature accepts the modification for the state.	☑Applicable Applicable for monitoring wells installed and monitored in sensitive riparian habitat where threatened species may exist Specific listed threatened species are: Ute-Ladies'-Tresses Orchid	Establishes "take provision"

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) Idaho Pole Company Focused Feasibility Study			
Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
Regulation | Montana Nongame And Endangered Species Act			
Presence of on-site endangered species	ARM 12.5.201 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=12%2E5%2E201 Rule Title: ENDANGERED SPECIES LIST Department: FISH, WILDLIFE, AND PARKS Chapter: RESOURCE PROTECTION Subchapter: Endangered Species 12.5.201 ENDANGERED SPECIES LIST (1) The following endangered species list is established in accordance with Title 87, chapter 5, MCA. Except as otherwise provided, it is unlawful for any person to take, possess, transport, export, sell or offer for sale, and for any common or contract carrier knowingly to transport or receive for shipment any species or subspecies of wildlife appearing on the following list: (a) whooping crane (*grus americana*); (b) Northern Rocky Mountain wolf (*canis lupus irremotus*); and (i) Subsection (1)(b) will be applied until the date the gray wolf in Montana is no longer subject to federal jurisdiction under the Endangered Species Act, 16 U.S.C. 1531, et seq., and the department and commission have sole jurisdiction over the management of the gray wolf in Montana. (c) black-footed ferret (*mustela nigripes*).	☑Applicable Applicable for monitoring wells installed and monitored in sensitive riparian habitat where endangered species may exist Specific species of State concern are: Foxtail Muhly (*Muhlnbergia andina*) Pale-yellow Jewel-weed (*Impatiens aurella)* Little brown Myotis (*Myotis lucifugus)* Veery (*Catharus fuscescens)* Hoary Bat (*Lsiurus cinereus*) Clark's Nutcracker (*Nucifraga columbiana*) Cassin's Finch (*Haemorhous cassinii*)	Prohibits certain activities with respect to endangered species

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Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
		Dwarf Purple Monkey Flower (*Mimulus nanus*) Townsend's Big-eared Bat (*Corynohinus townsendii*) Grizzly Bear (*Ursus arctos*) Wolverine (*Gulo gulo*) Small Yellow Lady's-slipper (*Cypripedium parviflorum*) Pacific Wren (*Trogloytes pacificus*) Rocky Mountain Twinpod (*Physaria saximontana v. dentata*) Hooked Snowfly (*Isocapnia crinite*) Western Pearlshell (*Margaritifera falcata*) Brown's Microcylloepus Riffle Beetle (*Microcylleopus browni*) Warm Spring Zaitzevian Riffle Beetle (*Zaitzevia thermae*) Fendler Cat's-eye (*Cryptantha fendleri*)	

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Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
		Whipple's Beardtongue (*Penstemon whippleanus*) Slender Wedgegrass (*Sphenopholis intermedia*) Small Dropseed (*Sporobolus neglectus*)	
Statute | Floodplain and Floodway Management Act			
Location of designated floodway	Section 76-5-401, MCA *Available at*: https://leg.mt.gov/bills/mca/title_0760/chapter_0050/part_0040/section_0010/0760-0050-0040-0010.html TITLE 76. LAND RESOURCES AND USE CHAPTER 5. FLOOD PLAIN AND FLOODWAY MANAGEMENT Part 4. Use of Flood Plains and Floodways **76-5-401. Permissible open-space uses.** The following open-space uses are permitted within the designated floodway to the extent that they are not prohibited by any other ordinance or statute and provided they do not require structures other than portable structures, fill, or permanent storage of materials or equipment: (1) agricultural uses; (2) industrial-commercial uses such as loading areas, parking areas, or emergency landing strips; (3) private and public recreational uses such as golf courses, tennis courts, driving ranges, archery ranges, picnic grounds, boat launching ramps, swimming areas, parks, wildlife management and natural areas, alternative livestock ranches, fish hatcheries, shooting preserves, target ranges, trap and skeet ranges, hunting and fishing areas, or hiking and horseback riding trails; (4) forestry, including processing of forest products with portable equipment; (5) residential uses such as lawns, gardens, parking areas, and play areas; (6) excavations subject to the issuance of a permit under **76-5-405** and **76-5-406**.	☑Applicable* *For activity qualifying as "industrial use" (e.g., monitoring well construction and related activity) *Cross-reference*: ARM 36.15.601	Provides that residential, certain agricultural, industrial-commercial, recreational, and other uses are permissible within the designated floodway, provided they do not require structures other than portable structures, fill, or permanent storage of materials or equipment.
Location of flood plain outside designated floodway	Section 76-5-402, MCA *Available at*: https://leg.mt.gov/bills/mca/title_0760/chapter_0050/part_0040/section_0020/0760-0050-0040-0020.html TITLE 76. LAND RESOURCES AND USE CHAPTER 5. FLOOD PLAIN AND FLOODWAY MANAGEMENT Part 4. Use of Flood Plains and Floodways	☑Applicable* *A monitoring well may constitute a "structure." *Cross-reference*: ARM 36.15.701	Provides that within the floodplain but outside the floodway, residential, commercial, industrial, and other structures may be permitted subject to certain conditions relating to placement of

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) Idaho Pole Company Focused Feasibility Study			
Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	76-5-402. Permissible uses within flood plain but outside floodway. Permits must be granted for the following uses within that portion of the flood plain not contained within the designated floodway to the extent that they are not prohibited by any other ordinance, regulation, or statute: (1) any use permitted in the designated floodway; (2) structures, including but not limited to residential, commercial, and industrial structures, provided that: (a) the structures meet the minimum standards adopted by the department; (b) residential structures are constructed so that the lowest floor elevation, including basements, is 2 feet above the 100-year flood elevation; (c) commercial and industrial structures are either constructed as specified in subsection (2)(b) or are adequately floodproofed up to an elevation no lower than 2 feet above the 100-year flood elevation. The floodproofing must be in accordance with the minimum standards adopted by the department.		fill, roads, and floodproofing.
	Section 76-5-403(2), MCA *Available at*: https://leg.mt.gov/bills/mca/title_0760/chapter_0050/part_0040/section_0030/0760-0050-0040-0030.html TITLE 76. LAND RESOURCES AND USE CHAPTER 5. FLOOD PLAIN AND FLOODWAY MANAGEMENT Part 4. Use of Flood Plains and Floodways **76-5-403. Prohibited uses within floodway.** The following nonconforming uses shall be prohibited within the designated floodway: (1) a building for living purposes or place of assembly or permanent use by human beings; **(2)** a structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway; (3) the construction or permanent storage of an object subject to flotation or movement during flood level periods.	☑Applicable* *A properly installed monitoring well will not cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway. If fitted with proper engineering controls such as a cap and lock, a monitoring well will not result in the disposal or storage of solid or hazardous waste. *Cross-reference*: ARM 36.15.605(1)(b), 2(c) and (d)	Prohibits the following in a floodway: any structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway; or the disposal or storage of solid or hazardous waste.
Regulation | Floodplain Management			

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
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Site-Specific Characteristics	Citation(s)	Prerequisite	Requirements
Location of use or obstruction of floodway or floodplain	ARM 36.15.216(2) *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=36%2E15%2E216 Rule Title: PERMITS - CRITERIA - TIME LIMITS Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: FLOODPLAIN MANAGEMENT Subchapter: Regulation and Enforcement **36.15.216** PERMITS - CRITERIA - TIME LIMITS (1) Permits shall be granted or denied by the permit issuing authority on the basis of whether the proposed new construction, substantial improvement, or alteration of an artificial obstruction meets the requirements of the Act and the minimum standards established by the board in these rules. (2) Additional factors that shall be considered for every permit application are: (a) the danger to life and property from backwater or diverted flow caused by the obstruction; (b) the danger that the obstruction will be swept downstream to the injury of others; (c) the availability of alternative locations; (d) the construction or alteration of the obstruction in such manner as to lessen the danger; (e) the permanence of the obstruction; (f) The anticipated development in the foreseeable future of the area which may be affected by the obstruction; and, (g) such other factors as are in harmony with the purposes of the Act and these rules. (3) A permit application is considered to have been automatically granted 60 days after receipt of the application, unless the permit issuing authority notifies the applicant before the 60th day that additional information is required, more time is required to process the application, or that the permit is denied.	☑Relevant and Appropriate	Contain substantive factors that address obstruction or use within the floodway or floodplain
Location of certain ag, C&I, recreational and other permissible uses within designated floodway	ARM 36.15.601 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=36%2E15%2E601 Rule Title: USES ALLOWED WITHOUT PERMITS Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: FLOODPLAIN MANAGEMENT Subchapter: Designated Floodway Minimum Standards **36.15.601** USES ALLOWED WITHOUT PERMITS (1) The following open space uses shall be allowed without a permit anywhere within the designated floodway provided that they are not prohibited by any other ordinance or statute and provided that they do not require structures other than portable structures, fill, or permanent storage of materials or equipment: (a) agricultural uses; (b) industrial-commercial uses such as loading areas, parking areas, and emergency landing strips; (c) private and public recreational uses such as golf courses, driving ranges, archery ranges, picnic grounds, boat-launching ramps, swimming areas, parks, wildlife management and natural areas, game farms, fish hatcheries, shooting preserves, target ranges, trap and skeet ranges, hunting and fishing areas, and hiking and horseback riding trails;	☑Relevant and Appropriate* *This is considered relevant and appropriate because of possible future monitoring well installation in the designated floodway and monitoring wells are not explicitly addressed in the regulations. *Cross-reference*: Section 76-5-401, MCA	Provides that residential, certain agricultural, industrial-commercial, recreational and other uses are permissible within the designated floodway, provided they do not require structures other than portable structures, fill, or permanent storage of materials or equipment

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Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	(d) forestry, including processing of forest products with portable equipment; and (e) residential uses such as lawns, gardens, parking areas, and play areas. (2) In addition to the uses specified in the preceding subsection, the following uses and their accessories do not in the judgment of the board endanger health or safety or cause increased flood heights and shall thus be allowed without a permit in the designated floodway: (a) irrigation and livestock supply wells provided that they are located at least 500 feet from domestic water supply wells; and (b) fences, except permanent fences crossing channels.		
Location of artificial obstructions within designated floodway	ARM 36.15.602(1), (5) *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=36.15.602 Rule Title: USES REQUIRING PERMITS Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: FLOODPLAIN MANAGEMENT Subchapter: Designated Floodway Minimum Standards **36.15.602** USES REQUIRING PERMITS In addition to the uses allowed under ARM 36.15.601, the following artificial obstructions may be permitted within the designated floodway subject to the issuance of a permit by the permit issuing authority under the conditions set forth in this rule and ARM 36.15.603 and 36.15.604: (1) excavation of material from pits or pools provided that: (a) a buffer strip of undisturbed land of sufficient width to prevent flood flows from channeling into the excavation is left between the edge of the channel and the edge of the excavation; (b) the excavation meets all applicable laws and regulations of other local and state agencies; and (c) excavated material is stockpiled outside the designated floodway; (2) railroad, highway, and street stream crossings provided that the crossings are designated to offer minimal obstruction to flood flow; (3) limited filling for highway, street, and railroad embankments not associated with stream crossings provided that: (a) reasonable alternative transportation routes outside the designated floodway are not available; and (b) such floodway encroachment is located as far from the stream channel as possible; (4) Buried or suspended utility transmission lines provided that: (a) suspended utility transmission lines are designed such that the lowest point of the suspended line is at least 6 feet higher than the elevation of the base flood; (b) towers and other appurtenant structures are designed and placed to withstand and offer minimal obstruction to flood flows; and (c) utility transmission lines carrying toxic or flammable materials are buried to a depth at least twice the calculated maximum depth of scour for the base flood. The maximum depth of scour may be determined from any of the accepted hydraulic engineering methods, but the final calculated figure shall be subject to approval by the permit issuing authority; (5) storage of materials and equipment provided that: (a) the material or equipment is not subject to major damage by flooding and is properly anchored to prevent flotation or downstream movement; or, (b) the material or equipment is readily removable within the limited time available after flood warning. Storage of flammable, toxic, or explosive materials shall not be permitted; (6) domestic water supply wells provided that: (a) they are driven or drilled wells located on ground higher than surrounding ground to assure positive drainage from the well;	☑Relevant and Appropriate	Provides that certain artificial obstructions may be permitted within the designated floodways subject to issuance of a permit

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Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	(b) well casings are watertight to a distance of at least 25 feet below the ground surface; (c) water supply and electrical lines have a watertight seal where the lines enter the casing; (d) all pumps and electrical lines and equipment are either of the submersible type or are adequately floodproofed; and (e) check valves are installed on main water lines at wells and at all building entry locations; (7) buried and sealed vaults for sewage disposal in recreational areas provided that they meet applicable laws and standards administered by the department of health and environmental sciences; (8) Public or private campgrounds provided that: (a) access roads require only limited fill and do not obstruct or divert flood waters; and, (b) no dwellings or permanent mobile homes are allowed; (9) structures accessory to the uses permitted in this subsection such as boat docks, marinas, sheds, permanent fences crossing channels, picnic shelters and tables, and toilets provided that: (a) the structures are not intended for human habitation; (b) the structures will have a low flood damage potential; (c) the structures will insofar as possible be located on ground higher than the surrounding ground and as far from the channel as possible; (d) the structures will be constructed and placed so as to offer a minimal obstruction to flood flows; (e) the structures will be firmly anchored to prevent flotation; and, (f) service facilities within these structures such as electrical, heating, and plumbing facilities are floodproofed in accordance with ARM 36.15.901 through 36.15.903; (10) all other artificial obstructions not specifically listed in this subsection or in ARM		
Location of structure or excavation with potential to cause water diversion	ARM 36.15.605(1)(b), (2(c) and (d) *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=36%2E15%2E605 Rule Title: PROHIBITED USES Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: FLOODPLAIN MANAGEMENT Subchapter: Designated Floodway Minimum Standards **36.15.605** PROHIBITED USES (1) The following artificial obstructions are prohibited within the designated floodway except as allowed by permit under ARM 36.15.602 through 36.15.604 and ARM 36.15.606: (a) a building for living purposes or place of assembly or permanent use by human beings; (b) a structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway; (c) the construction or permanent storage of any object subject to floatation or movement during flood level periods. (2) The following artificial obstructions are also prohibited within the designated floodway: (a) mobile homes and manufactured homes; (b) commercial buildings; (c) solid and hazardous waste disposal and individual or multiple family sewage disposal systems; (d) storage of toxic, flammable, hazardous, or explosive materials.	☑Applicable* *This is applicable because of possible future monitoring well installation in the floodway need to be constructed to ensure no water diversion *Cross-reference*: Section 76-5-403(2), MCA	Prohibits the following in a floodway: any structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway; or the disposal or storage of solid or hazardous waste
Location of flood control works	ARM 36.15.606 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=36%2E15%2E606 Rule Title: PERMITS FOR FLOOD CONTROL WORKS	☑Relevant and Appropriate	Provides that flood control works comply with safety standards for levees, floodwalls, and riprap

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) Idaho Pole Company Focused Feasibility Study			
Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: FLOODPLAIN MANAGEMENT Subchapter: Designated Floodway Minimum Standards **36.15.606** PERMITS FOR FLOOD CONTROL WORKS (1) Since structural flood control works often significantly obstruct and affect floodway flow capacity, the following flood control measures shall be allowed within designated floodways subject to the issuance of a permit by the permit issuing authority and certification by a registered professional engineer of compliance with the conditions set forth in this rule: (a) Flood control levees and floodwalls if: (i) the proposed levees and floodwalls are designed and constructed to safely convey the base flood; (ii) the cumulative effect of the levees and floodwalls combined with allowable flood fringe encroachments does not increase the unobstructed elevation of the base flood more than 0.5 of a foot at any point; (b) riprap, except that which is hand placed, if: (i) the riprap is designed to withstand the base flood; (ii) the riprap does not increase the elevation of the base flood; (iii) the riprap will not increase erosion upstream, downstream, or across stream from the riprap site; (c) channelization projects if they do not significantly increase the magnitude, velocity, or elevation of the flood; (d) dams provided that: (i) they are designed and constructed in accordance with approved safety standards, and the Montana Dam Safety Act; (ii) they will not increase flood hazards downstream either through operational procedures or improper hydrologic design. (2) The permit issuing authority may establish either a lower or higher permissible increase in the elevation of the base flood than that established in subsection (1) (a) (ii) for individual levee projects based on consideration of the following criteria: (a) the proposed levees and floodwalls, except those to protect agricultural land only, are constructed at least 3 feet higher than the elevation of the base flood; (b) the estimated cumulative effect of other reasonably anticipated future permissible uses; (c) the type and amount of existing flood prone development in the affected area; (d) no detrimental impact occurs to existing or foreseeable development.		
Location of certain structures within the floodplain but outside designated floodway	ARM 36.15.701 *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=36%2E15%2E701 Rule Title: ALLOWED USES Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: FLOODPLAIN MANAGEMENT Subchapter: Flood Fringe Minimum Standards **36.15.701** ALLOWED USES (1) All uses allowed in the designated floodway without a permit under ARM 36.15.601 shall also be allowed without a permit in the flood fringe. (a) In addition, individual or multiple family subsurface sewage disposal systems are allowed only when they are reviewed and approved under laws and regulations administered by the department of health and environmental sciences or the local health board. (2) All uses allowed in the designated floodway subject to the issuance of a permit under ARM 36.15.602 through 36.15.604 and ARM 36.15.606 shall also be allowed in the flood fringe subject to the issuance of a permit. (3) In addition, structures including, but not limited to residential, commercial, and industrial structures, and suitable fill shall be allowed by permit from the permit issuing authority within the flood fringe subject to the following conditions and the requirements of ARM 36.15.702 and 36.15.901 through 36.15.903: (a) Such structures or fill must not be prohibited by any other statute, regulation, ordinance, or resolution;	☑Applicable* *This is applicable because of possible future monitoring well installation in the flood fringe *Cross-reference*: Section 76-5-402, MCA	Provides that within the floodplain but outside the floodway, residential, commercial, industrial, and other structures may be permitted subject to certain conditions relating to placement of fill, roads, and floodproofing

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Site-Specific Characteristics	Citation(s)	Prerequisite	Requirements
	(b) Such structures or fill must be compatible with local comprehensive plans, if any; (c) Roads, streets, highways, and rail lines shall be designed to minimize increases in flood heights. Where failure or interruption of transportation facilities would result in danger to the public health or safety, the facilities shall be located 2 feet above the elevation of the base flood; (d) Public or private structures and facilities for liquid or solid waste treatment and disposal must be floodproofed to insure that no pollutants enter flood waters. These facilities must be allowed and approved under laws and standards administered by the department of health and environmental sciences prior to any approval given by the permit issuing authority; and (e) Agricultural structures that have a low flood damage potential such as sheds, barns, shelters, and hay and grain storage structures must meet the requirements of ARM 36.15.602(9).		
Location of solid and haz waste disposal within flood fringe	ARM 36.15.703 *Available At*: http://www.mtrules.org/gateway/RuleNo.asp?RN=36.15.703 Rule Title: PROHIBITED USES Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: FLOODPLAIN MANAGEMENT Subchapter: Flood Fringe Minimum Standards **36.15.703** PROHIBITED USES The following artificial obstructions and nonconforming uses are prohibited within the flood fringe: (1) solid and hazardous waste disposal; and (2) storage of toxic, flammable, hazardous, or explosive materials. Storage of petroleum products may be allowed by permit if stored on compacted fill at least 2 feet above the elevation of the base flood and anchored to a permanent foundation that is properly anchored to the ground.	☑Applicable* *In situ amendments may be toxic, flammable, hazardous or explosive material and storage within flood fringe would not be allowable	Provides that solid and hazardous waste disposal and storage of flammable, toxic, hazardous, or explosive materials are prohibited anywhere in the floodways or floodplains

PAGE MARKER: ACTION SPECIFIC REQUIREMENTS

Action-specific requirements are technology or activity based requirements or limitations or actions taken with respect to hazardous substances.

Statute | Montana Water Quality Act			
Generally prohibiting degradation of high quality state waters	Section 75-5-303, MCA *Available at*: https://leg.mt.gov/bills/mca/title_0750/chapter_0050/part_0030/section_0030/0750-0050-0030-0030.html TITLE 75. ENVIRONMENTAL PROTECTION CHAPTER 5. WATER QUALITY Part 3. Classification and Standards **Nondegradation policy.** (1) Existing uses of state waters and the level of water quality necessary to protect those uses must be maintained and protected.	☑Applicable Groundwater at the Site has a Class 1 designation *Cross-reference*: ARM 17.30.1011	Provides that existing uses of state waters and the level of water quality necessary to protect those uses must be maintained and protected. Provides also that MDEQ may not authorize degradation unless certain criteria are met

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Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	(2) Unless authorized by the department under subsection (3) or exempted from review under **75-5-317**, the quality of high-quality waters must be maintained. (3)-(8) [Omitted; Administrative]		
Causing "pollution" of state waters	Section 75-5-605(a), (c), MCA *Available at*:https://leg.mt.gov/bills/mca/title_0750/chapter_0050/part_0060/section_0050/0750-0050-0060-0050.html TITLE 75. ENVIRONMENTAL PROTECTION CHAPTER 5. WATER QUALITY Part 6. Enforcement, Appeal, and Penalties It is unlawful to: (a) cause pollution, as defined in **75-5-103**, of any state waters or to place or cause to be placed any wastes where they will cause pollution of any state waters. Any placement of materials that is authorized by a permit issued by any state or federal agency is not a placement of wastes within the prohibition of this subsection (1)(a) if the agency's permitting authority includes provisions for review of the placement of materials to ensure that it will not cause pollution of state waters. (b) violate any provision set forth in a permit or stipulation, including but not limited to limitations and conditions contained in the permit; (c) cause degradation of state waters without authorization pursuant to **75-5-303**; (d) violate any order issued pursuant to this chapter; or (e) violate any provision of this chapter. (2) Except for the permit exclusions identified in **75-5-401**(5), it is unlawful to carry on any of the following activities without a current permit from the department: (a) construct, modify, or operate a disposal system that discharges into any state waters; (b) construct or use any outlet for the discharge of sewage, industrial wastes, or other wastes into any state waters; or (c) discharge sewage, industrial wastes, or other wastes into any state waters. (3) Activities associated with routine or periodic maintenance, repair, replacement, or operation of irrigation water conveyance systems, including activities associated with any constructed channel, canal, ditch, pipeline, or portion of any constructed channel, canal, ditch, or pipeline, are not prohibited activities under this chapter if the activities do not result in exceeding water quality standards for any receiving water outside the irrigation water conveyance system. The diversion of water in accordance with an existing water right or permit pursuant to Title 85, chapter 2, is not a prohibited activity under this chapter.	☑Applicable* *This provision would apply to remediation activities at the Site and could be met via BMPs, design, etc. See Section 75-5-103(30, MCA): Definition of "Pollution" (DEQ-7 exceedances of water quality standards (risk-based element))	Prohibits placement (or causing to be placed) any wastes where they will cause pollution of any state waters. Any placement of materials that is authorized by a permit issued by any state or federal agency is not a placement of wastes within the prohibition of this subsection (1)(a) if the agency's permitting authority includes provisions for review of the placement of materials to ensure that it will not cause pollution of state waters
Regulation | Water Quality			
Generally prohibiting degradation of high quality state waters	ARM 17.30.1011 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E30%2E1011 Rule Title: NONDEGRADATION Department: Environmental Quality Chapter: Water Quality Subchapter: Montana Ground Water Control System **17.30.1011** NONDEGRADATION	☑Applicable Groundwater at the Site has a Class 1 designation	Establishes prohibition against degradation of high quality state waters

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Site-Specific Characteristics	Citation(s)	Prerequisite	Requirements
	(1) Any ground water whose existing quality is higher than the established groundwater quality standards for its classification must be maintained at that high quality in accordance with 75-5-303 , MCA, and ARM Title 17, chapter 30, subchapter 7.		
Discharging storm water associated with construction activity	ARM 17.30.1115(6)(c) *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=17%2E30%2E1115 Rule Title: NOTICE OF INTENT PROCEDURES: CONSTRUCTION ACTIVITY Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: WATER QUALITY Subchapter: Storm Water Discharges **17.30.1115** NOTICE OF INTENT PROCEDURES: CONSTRUCTION ACTIVITY (1) A person who discharges or proposes to discharge storm water associated with construction activity shall submit to the department a notice of intent (NOI) as provided in this rule. (a) The NOI must be signed by the owner of the project or by the operator, or by both the owner and the operator if both have responsibility to ensure that daily project activities comply with the SWPPP and other general permit conditions. If more than one operator is responsible for compliance with the SWPPP and general permit each operator shall sign the NOI. (i) persons signing an NOI shall comply with the permit application signature requirements set out in ARM 17.30.1323. (b) For storm water discharges associated with construction activity that result in construction-related disturbance of less than five acres of total land area, the permit requirements in this subchapter are effective beginning March 10, 2003. (2) An NOI must be completed on an NOI form developed by the department. The NOI must be completed in accordance with the requirements stated in the general permit, and must include the legal name and address of the operators, the facility name and address, the type of facility or discharges, and the receiving surface waters. (a) An NOI must include a narrative description of: (i) the location (including a map) and the nature of the construction activity; (ii) the total area of the site and the area within the site that is expected to undergo excavation during the life of the permit; (iii) proposed measures, including BMPs, to control pollutants in storm water discharges during construction, including a brief description of applicable local erosion and sediment control requirements; (iv) proposed measures to control pollutants in storm water discharges that will occur after construction operations have been completed, including a brief description of applicable local erosion and sediment control requirements; (v) for a storm water discharge that will result in construction-related disturbance of five acres or more of total land area, an estimate of the runoff coefficient of the site and the increase in impervious area after the construction addressed in the permit application is completed, the nature of fill material and existing data describing the soil or the quality of the discharge; and (vi) the name of the receiving surface waters. (3) An NOI must be accompanied by a SWPPP, which must be completed in accordance with the requirements identified in the general permit including the following: (a) the SWPPP must be signed by all signatories to the NOI; and (b) the SWPPP must require the identification and assessment of potential pollutant sources that could be exposed to storm water runoff, and must contain provisions to implement BMPs, in accordance with the general permit. (4) Authorization to discharge under the general permit is effective upon receipt by the department of a complete notice of intent and SWPPP, together with the permit fee, by the date on which construction-related disturbance is initiated. (5) The department may include, in the general permit for storm water discharges associated with construction activity, conditions that incorporate by reference qualifying local erosion and sediment control program requirements. A "qualifying local erosion and sediment control program" is one that includes the elements listed in (6) and all additional requirements necessary to achieve the applicable technology-based standards of best available technology (BAT) and best conventional technology (BCT) . If a qualifying local program does not include one or more of the elements in (6) , then the department shall include those elements as conditions in the permit.	☑Relevant and Appropriate* *This rule would apply to remedial action construction activities that may result in direct discharges of storm water to State Waters.	Provides for development and implementation of a SWPPP to properly manage storm water discharges associated with construction activities

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	(6) A qualifying local erosion and sediment control program includes requirements for construction site operators to: (a) implement appropriate erosion and sediment control BMPs; (b) control waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at the construction site that may cause adverse impacts to water quality; (c) develop and implement a SWPPP. A SWPPP includes site descriptions, descriptions of appropriate control measures, copies of approved local requirements, maintenance procedures, inspection procedures, and identification of non-storm water discharges; and (d) submit a site plan for review that incorporates consideration of potential water quality impacts. (7) Permittees shall keep records of all data used to complete the NOI and SWPPP and any supplemental information submitted under this subchapter for a period of at least three years from the date the NOI is signed.		
Discharging water	17.30.1203(1), (3), (5), (8) *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=17.30.1203 Rule Title: CRITERIA AND STANDARDS FOR IMPOSING TECHNOLOGY-BASED TREATMENT REQUIREMENTS IN MPDES PERMITS - VARIANCE PROCEDURES Department: ENVIRONMENTAL QUALITY Chapter: WATER QUALITY Subchapter: Montana Pollutant Discharge Elimination System (MPDES) Standards **17.30.1203** CRITERIA AND STANDARDS FOR IMPOSING TECHNOLOGY-BASED TREATMENT REQUIREMENTS IN MPDES PERMITS - VARIANCE PROCEDURES (1) Technology-based treatment requirements under section 301(b) of the federal Clean Water Act represent the minimum level of control that must be imposed in MPDES permits. Unless a more stringent effluent limitation applies under ARM 17.30.1344, permits issued by the department must contain the applicable technology-based treatment requirements provided in (2) and (3), according to the applicable deadlines. (2) For POTWs, effluent limitations must be based upon secondary treatment as defined in 40 CFR Part 133, from date of permit issuance. (3) For dischargers other than POTWs except as provided in ARM 17.30.1340(5), effluent limitations must require: (a) the best practicable control technology currently available (BPT) in accordance with the following schedules: (i) for effluent limitations promulgated under section 304(b) of the federal Clean Water Act after January 1, 1982, and requiring a level of control substantially greater or based on fundamentally different control technology than under permits for an industrial category issued before such date, compliance is required as expeditiously as practicable, but in no case later than March 31, 1989; (ii) for effluent limitations established on a case-by-case basis based on best professional judgment (BPJ) under (5) in a permit issued after February 4, 1987, compliance is required as expeditiously as practicable, but in no case later than March 31, 1989; (iii) for all other BPT effluent limitations compliance is required from the date of permit issuance. (b) for conventional pollutants, the best conventional pollutant control technology (BCT) in accordance with the following schedule: (i) for effluent limitations promulgated under section 304(b) of the federal Clean Water Act, compliance is required as expeditiously as practicable, but in no case later than such limitations are promulgated, and in no case later than March 31, 1989; (ii) for effluent limitations established on a case-by-case basis based on BPJ under (5) in a permit issued after February 4, 1987, compliance is required as expeditiously as practicable, but in no case later than March 31, 1989. (c) for all toxic pollutants identified in 40 CFR 401.15, the best available technology economically achievable (BAT) in accordance with the following schedule:	☑Applicable* *This is consistent with the proposed PRAO, which states: *"Ensure there are not groundwater impacts to surface water above DEQ-7 standards or MCLs and/or receptors beyond the boundary of the CGA"* *No surface water samples are collected at the Site. Monitoring of compliance wells in proximity to Rocky Creek will ensure compliance with the PRAO. Additionally, the Barkfill Source area has been well characterized and may be considered a functionally	Provides for technology-based treatment requirements under section 301(b) of the federal Clean Water Act

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Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	(i) for effluent limitations promulgated under section 304(b) of the federal Clean Water Act, compliance is required as expeditiously as practicable, but in no case later than March 31, 1989; (ii) for permits issued on a case-by-case basis based on BPJ under (5) after February 4, 1987, compliance is required as expeditiously as practicable, but in no case later than March 31, 1989. (d) for all pollutants which are neither toxic nor conventional pollutants, effluent limitations based on BAT in accordance with the following schedule: (i) for effluent limitations promulgated under section 304(b) of the federal Clean Water Act, compliance is required as expeditiously as practicable, but in no case later than March 31, 1989; (ii) for permits issued on a case-by-case basis based on BPJ under (5) after February 4, 1987, establishing BAT effluent imitations, compliance is required as expeditiously as practicable, but in no case later than March 31, 1989. (4) The following variances from technology-based treatment requirements may be applied for and incorporated into MPDES permits: (a) for dischargers other than POTWs, a variance from effluent limitations promulgated under sections 301 and 304 of the federal Clean Water Act based on fundamentally different factors in accordance with 40 CFR Part 125, Subpart D; (b) for dischargers other than POTWs, a water quality related variance from BAT for certain nonconventional pollutants under section 301(g) of the federal Clean Water Act; and (c) a thermal variance from BPT, BCT, and BAT under section 316(a) of the federal Clean Water Act in accordance with ARM 17.30.1210. (5) Technology-based treatment requirements may be imposed through one of the following methods provided in (a) through (c): (a) application of EPA-promulgated effluent limitations guidelines for dischargers by category or subcategory. These effluent limitations are not applicable to the extent that they have been remanded or withdrawn. However, in the case of a court remand, determinations underlying effluent limitations must be binding in permit issuance proceedings where those determinations are not required to be reexamined by a court remanding the regulations. In addition, dischargers may seek fundamentally different factors variances from these effluent limitations pursuant to 40 CFR, Part 125, Subpart D; (b) on a case-by-case basis using BPJ to the extent that EPA-promulgated effluent limitations are inapplicable. The permit writer shall apply the appropriate factors listed in (6) and shall consider: (i) the appropriate technology for the category or class of point sources of which the applicant is a member, based upon all available information; and (ii) any unique factors relating to the applicant. (c) through a combination of the methods described in (a) and (b). Where promulgated effluent limitations guidelines only apply to certain aspects of the discharger's operation, or to certain pollutants, other aspects or activities are subject to regulation on a case-by-case basis in order to carry out the provisions of the federal Clean Water Act; (d) limitations developed under (6)(b) may be expressed, where appropriate, in terms of toxicity (e.g., "the LC50 for fat head minnow of the effluent from outfall 001 shall be greater than 25%"), provided that the limits reflect the appropriate requirements (for example, technology-based or water quality-based standards) of the federal Clean Water Act. (6) In setting case-by-case limitations pursuant to (5), the permit writer shall consider the following factors: (a) for BPT requirements: (i) the total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application; (ii) the age of equipment and facilities involved; (iii) the process employed; (iv) the engineering aspects of the application of various types of control techniques; (v) process changes; and (vi) non-water quality environmental impact (including energy requirements). (b) for BCT requirements: (i) the reasonableness of the relationship between the costs of attaining a reduction in effluent and the effluent reduction benefits derived;	equivalent direct discharge. The cited subsections of this ARM would apply to functionally equivalent direct discharges to State Waters from the aforementioned source area.	

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	(ii) the comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources; (iii) the age of equipment and facilities involved; (iv) the process employed; (v) the engineering aspects of the application of various types of control techniques; (vi) process changes; and (vii) non-water quality environmental impact (including energy requirements). (c) for BAT requirements: (i) the age of equipment and facilities involved; (ii) the process employed; (iii) the engineering aspects of the application of various types of control techniques; (iv) process changes; (v) the cost of achieving such effluent reduction; and (vi) non-water quality environmental impact (including energy requirements). (7) Technology-based treatment requirements are applied prior to or at the point of discharge. (8) Technology-based treatment requirements cannot be satisfied through the use of "non-treatment" techniques such as flow augmentation and in-stream mechanical aerators. However, these techniques may be considered as a method of achieving water quality standards on a case-by-case basis when: (a) the technology-based treatment requirements applicable to the discharge are not sufficient to achieve the standards; (b) the discharger agrees to waive any opportunity to request a variance under section 301(c), (g), or (h) of the federal Clean Water Act; and (c) the discharger demonstrates that such a technique is the preferred environmental and economic method to achieve the standards after consideration of alternatives such as advanced waste treatment, recycle and reuse, land disposal, changes in operating methods, and other available methods. (9) Technology-based effluent limitations must be established under this rule for solids, sludges, filter backwash, and other pollutants removed in the course of treatment or control of wastewaters in the same manner as for other pollutants. (10) The department may set a permit limit for a conventional pollutant at a level more stringent than the best conventional pollution control technology BCT, or a limit for a nonconventional pollutant which must not be subject to modification under section 301(c) or (g) of the federal Clean Water Act where: (a) effluent limitations guidelines specify the pollutant as an indicator for a toxic pollutant; or (b) the limitation reflects BAT-level control of discharges of one or more toxic pollutants that are present in the waste stream, and a specific BAT limitation upon the toxic pollutant(s) is not feasible for economic or technical reasons; (c) the permit identifies which toxic pollutants are intended to be controlled by use of the limitation; and (d) the fact sheet required by ARM 17.30.1371 sets forth the basis for the limitation, including a finding that compliance with the limitation will result in BAT-level control of the toxic pollutant discharges identified in (c), and a finding that it would be economically or technically infeasible to directly limit the toxic pollutant(s). (11) The department may set a permit limit for a conventional pollutant at a level more stringent than BCT when: (a) effluent limitations guidelines specify the pollutant as an indicator for a hazardous substance; or (b) the limitation reflects BAT-level control of discharges, or an appropriate level determined under section 301(c) or (g) of the federal Clean Water Act, of one or more hazardous substance(s) that are present in the waste stream, and a specific BAT or other appropriate limitation upon the hazardous substance(s) is not feasible for economic or technical reasons; (c) the permit identifies which hazardous substances are intended to be controlled by use of the limitation; and (d) the fact sheet required by ARM 17.30.1371 sets forth the basis for the limitation, including a finding that compliance with the limitations will result in BAT-level (or other appropriate level) control of the hazardous substances discharges identified in (c), and a finding that it would be economically or technically infeasible to directly limit the hazardous substance(s). (e) Hazardous substances that are also toxic pollutants are subject to (10). (12) The department may not set a more stringent limit under the preceding sections if the method of treatment required to comply with the limit differs from that which would be required if the toxic pollutant(s) or hazardous substance(s) controlled by the limit were limited directly.		

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	(13) Toxic pollutants identified under (10) remain subject to the requirements of ARM 17.30.1343(1)(a) (notification of increased discharges of toxic pollutants above levels reported in the application form). (14) The board adopts and incorporates by reference the following federal regulations as part of the MPDES: (a) 40 CFR Part 133 (July 1, 2010), which sets forth the level of effluent quality attainable through the application of secondary treatment or equivalent treatment for POTWs; (b) 40 CFR Part 125, Subpart D (July 1, 2010), which sets forth criteria and standards for determining fundamentally different factors under section 301 of the federal Clean Water Act; (c) 40 CFR 401.15 (July 1, 2010), which is a list of toxic pollutants identified by EPA under section 307(a)(1) of the federal Clean Water Act. (d) Copies of these federal regulations may be obtained from the Department of Environmental Quality, Water Protection Bureau, P.O. Box 200901, Helena, MT 59620.		
Discharging water from point source	ARM 17.30.1207(1) *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=17.30.1207 Rule Title: EFFLUENT LIMITATIONS AND STANDARDS OF PERFORMANCE Department: ENVIRONMENTAL QUALITY Chapter: WATER QUALITY Subchapter: Montana Pollutant Discharge Elimination System (MPDES) Standards 17.30.1207 EFFLUENT LIMITATIONS AND STANDARDS OF PERFORMANCE **(1) Permits issued to point source dischargers, other than POTWs, must include effluent limitations or standards of performance applicable to the point source that are set forth in 40 CFR Chapter I, Subchapter N, as provided below:** **(a) for existing sources, effluent limitations representing the degree of effluent reduction attainable by the application of:** **(i) the best practicable control technology currently achievable (BPT) for all pollutants;** **(ii) the best available technology economically achievable (BAT) for toxic and nonconventional pollutants; and** **(iii) the best conventional pollutant control technology (BCT) for conventional pollutants;** **(b) for new sources, new source performance standards (NSPS) reflecting the best available demonstrated control technology, processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge.** (2) The department shall ensure that the applicable effluent limitations or standards of performance set forth in 40 CFR Chapter I, Subchapter N, are included in any new MPDES permit, renewed MPDES permit, or permit modification issued in accordance with ARM Title 17, chapter 30, subchapter 13. (3) The board adopts and incorporates by reference 40 CFR Chapter I, Subchapter N (except 40 CFR Part 403) (July 1, 2010), which sets forth federal effluent limitations and standards for existing sources and standards of performance for new sources, which are promulgated by EPA under sections 301, 304(b), 306(b), and 316(b) of the federal Clean Water Act. 40 CFR Part 403, which is excluded from this incorporation by reference, sets forth general pretreatment requirements for new and existing sources. A copy of the incorporated federal regulations may be obtained from the Department of Environmental Quality, Water Protection Bureau, P.O. Box 200901, Helena, MT 59620.	*No surface water samples are collected at the Site. Monitoring of compliance wells in proximity to Rocky Creek will ensure compliance with the PRAO. The Barkfill Source area has been well characterized and may be considered a functionally equivalent direct discharge. The cited subsections of this ARM would apply to functionally equivalent direct discharges to State Waters from the aforementioned source area.	Provides for effluent limitations and standards of discharges for point source dischargers other than POTWs
Constructing and excavating affecting water quality	ARM 17.30.1342(4), (5) *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=17.30.1342 Rule Title: CONDITIONS APPLICABLE TO ALL PERMITS	☑Applicable* *Subparagraphs (4) and (5) are substantive in nature, and are intended to	The State of Montana has been delegated the authority to implement the Clean Water Act and these requirements are enforced in Montana

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	Department: ENVIRONMENTAL QUALITY Chapter: WATER QUALITY Subchapter: Montana Pollutant Discharge Elimination System (MPDES) Permits **17.30.1342** CONDITIONS APPLICABLE TO ALL PERMITS The following conditions apply to all MPDES permits. Additional conditions applicable to MPDES permits are set forth in ARM 17.30.1344. All conditions applicable to MPDES permits must be incorporated into the permits either expressly or by reference. If incorporated by reference, a specific citation to these rules must be given in the permit. (1) The permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. (a) The permittee shall comply with effluent standards or prohibitions established under ARM 17.30.1206 for toxic pollutants within the time provided in the rules that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement. (b) The Act provides that any person who violates a permit condition is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates a permit condition is subject to a fine not to exceed $25,000 per day of violation or imprisonment for not more than one year, or both. (2) If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee shall first apply for and obtain a new permit. (3) It may not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. (4) The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment. (5) The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit. (6) This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition. (7) This permit does not convey any property rights of any sort, or any exclusive privilege. (8) The permittee shall furnish to the department, within a reasonable time, any information which the department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish to the department upon request, copies of records required to be kept by this permit. (9) The permittee shall allow the department, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to: (a) enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit; (b) have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit; (c) inspect at reasonable times any facilities, equipment (including monitoring and control equipment) , practices, or operations regulated or required under this permit; and (d) sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location. (10) Monitoring and records: (a) Samples and measurements taken for the purpose of monitoring must be representative of the monitored activity.	ensure that runoff from well drilling and other remedial action do not result in run-off into surface waters during a rainstorm or high water event.	through the MPDES. These regulations set forth the substantive requirements applicable to all MPDES and National Pollutant Discharge Elimination System permits. The substantive requirements, including the requirement to properly operate and maintain all facilities and systems of treatment and control, and applicable requirements

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	(b) The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the department at any time. (c) Records of monitoring information must include: (i) the date, exact place, and time of sampling or measurements; (ii) the individual(s) who performed the sampling or measurements; (iii) the date(s) analyses were performed; (iv) the individual(s) who performed the analyses; (v) the analytical techniques or methods used; and (vi) the results of such analyses. (d) Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit. (11) All applications, reports, or information submitted to the department must be signed and certified. (See ARM 17.30.1323.) (12) Reporting requirements: (a) The permittee shall give notice to the department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when: (i) the alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in ARM 17.30.1340(2); or (ii) the alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under ARM 17.30.1343(1)(a). (b) The permittee shall give advance notice to the department of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements. (c) This permit is not transferable to any person except after notice to the department. The department may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Act. (See ARM 17.30.1360; in some cases, modification or revocation and reissuance is mandatory.) (d) Monitoring results must be reported at the intervals specified elsewhere in this permit. (i) Monitoring results must be reported on a discharge monitoring report (DMR). (ii) If the permittee monitors any pollutant more frequently than required by the permit, using test procedures approved under 40 CFR 136 or as specified in the permit, the results of this monitoring must be included in the calculation and reporting of the data submitted in the DMR. (iii) Calculations for all limitations which require averaging of measurements must utilize an arithmetic mean unless otherwise specified by the department in the permit. (e) Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit must be submitted no later than 14 days following each schedule date. (f) Twenty-four hour reporting: (i) The permittee shall report any noncompliance which may endanger health or the environment. Any information must be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission must also be provided within five days of the time the permittee becomes aware of the circumstances. The written submission must contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. (ii) The following must be included as information which must be reported within 24 hours under this rule: (A) any unanticipated bypass which exceeds any effluent limitation in the permit (see ARM 17.30.1342(7)); (B) any upset which exceeds any effluent limitation in the permit; and		

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	(C) violation of a maximum daily discharge limitation for any of the pollutants listed by the department in the permit to be reported within 24 hours (see ARM 17.30.1344 and 40 CFR 122.44(g)). (iii) The department may waive the written report on a case-by-case basis for reports under (ii) above if the oral report has been received within 24 hours. (g) The permittee shall report all instances of noncompliance not reported under (a), (d), (e), and (f), at the time monitoring reports are submitted. The reports must contain the information listed in (f). (h) Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the department, it shall promptly submit such facts or information. (13) Other noncompliance: (a) The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of (b) and (c). (b) If the permittee knows in advance of the need for a bypass, it shall submit prior notice to the department, if possible at least 10 days before the date of the bypass. The permittee shall submit notice of an unanticipated bypass as required in (12)(f) (24-hour notice). (c) Bypass is prohibited, and the department may take enforcement action against a permittee for bypass, unless: (i) bypass was unavoidable to prevent loss of life, personal injury, or severe property damage; (ii) there were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and (iii) the permittee submitted notices as required under (c). (d) The department may approve an anticipated bypass, after considering its adverse effects, if the department determines that it will meet the three conditions listed above in (c)(i). (14) Upset Conditions: (a) Effect of an upset: An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of (b) are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review. (b) Conditions necessary for demonstration of an upset: A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that: (i) an upset occurred and that the permittee can identify the cause(s) of the upset; (ii) the permitted facility was at the time being properly operated; (iii) the permittee submitted notice of the upset as required in (12)(f)(ii)(B) (24-hour notice); and (iv) the permittee complied with any remedial measures required under (4). (c) Burden of proof: In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof. (15) The board adopts and incorporates by reference: (a) 40 CFR Part 136, which is a series of federal agency rules setting forth guidelines establishing test procedures for the analysis of pollutants; and (b) 40 CFR 122.44(g), which is a federal agency rule requiring 24-hour notice of any violation of maximum daily discharge limits.		
Regulation | Stormwater Runoff Control Requirements			
Managing stormwater and dewatering	ARM 17.30.1344(1), (2)(b), (e), (f) *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E30%2E1344	☑Applicable	Requires a storm water permit for storm water point sources.

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Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	Rule Title: ESTABLISHING LIMITATIONS, STANDARDS, AND OTHER PERMIT CONDITIONS Department: ENVIRONMENTAL QUALITY Chapter: WATER QUALITY Subchapter: Montana Pollutant Discharge Elimination System (MPDES) Permits 17.30.1344 ESTABLISHING LIMITATIONS, STANDARDS, AND OTHER PERMIT CONDITIONS (1) In addition to the conditions established under ARM 17.30.1342, 17.30.1343, 17.30.1346, 17.30.1350, and 17.30.1351, each MPDES permit must include conditions meeting the requirements stated in 40 CFR 122.43, 122.44, 124.56, and 124.57 (July 1, 1991). (2) The board hereby adopts and incorporates herein by reference: (a) 40 CFR 122.43 (July 1, 1991), which is a federal rule that establishes applicable permit conditions in general; (b) 40 CFR 122.44 (July 1, 1991), which is a federal agency rule setting forth additional permit conditions which may be applicable to a point source. Such conditions include technology-based and water-quality-based standards, toxic and pretreatment standards, reopener clause, reporting and monitoring requirements, permit duration and reissuance, test methods, best management practices, conditions concerning sewage sludge, privately owned treatment works, and conditions imposed in EPA grants to POTW's; (c) 40 CFR 124.56 (July 1, 1991), which describes requirements for fact sheets; (d) 40 CFR 124.57 (July 1, 1991), which describes the public notice that must be provided for draft permits; (e) 40 CFR chapter 1, subchapter N, (July 1, 1991), which sets forth federal effluent limitations and standards and new source performance standards; (f) 40 CFR Part 125 (July 1, 1991), which states standards and criteria for the national point discharge elimination system; (g) 40 CFR Part 129 (July 1, 1991), which describes toxic effluent pollutant standards; and (h) 40 CFR Part 133, (July 1, 1991), which sets forth requirements for secondary treatment regulation. (i) Copies of the above listed materials are available from the Department of Environmental Quality, P.O. Box 200901, Helena, MT 59620-0901.		Generally, the permits require the permittee to implement best management practices (BMPs) and to take all reasonable steps to minimize or prevent any discharge which has a reasonable likelihood of adversely affecting human health or the environment. However, if there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with the activity, an individual MPDES permit or alternative general permit may be required
Statute | Water			
Wasting & contaminating ground water	Section 85-2-505, MCA *Available at*: https://leg.mt.gov/bills/mca/title_0850/chapter_0020/part_0050/section_0050/0850-0020-0050-0050.html TITLE 85. WATER USE CHAPTER 2. SURFACE WATER AND GROUND WATER Part 5. Ground Water **85-2-505. Waste and contamination of ground water prohibited.** (1) No ground water may be wasted. The department shall require all wells producing waters that contaminate other waters to be plugged or capped. It shall also require all flowing wells to be so capped or equipped with valves that the flow of water can be stopped when the water is not being put to beneficial use. Likewise, both flowing and nonflowing wells must be so constructed and maintained as to prevent the waste, contamination, or pollution of ground water through leaky casings, pipes, fittings, valves, or pumps either above or below the land surface. However, in the following cases the withdrawal or use of ground water may not be construed as waste under this part: (a) the withdrawal of reasonable quantities of ground water in connection with the construction, development, testing, or repair of a well or other means of withdrawal of ground water;	☑Applicable* *This provision would apply to remedial actions that involve maintenance or upgrades to existing wells or construction of new wells and withdrawal of groundwater.	Precludes the wasting of groundwater. Any well producing waters that contaminate other waters must be plugged or capped, and wells must be constructed and maintained so as to prevent waste, contamination, or pollution of groundwater

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	(b) the inadvertent loss of ground water owing to breakage of a pump, valve, pipe, or fitting, if reasonable diligence is shown by the person in effecting the necessary repair; (c) the disposal of ground water without further beneficial use that must be withdrawn for the sole purpose of improving or preserving the utility of land by draining the same or that must be removed from a mine to permit mining operations or to preserve the mine in good condition; (d) the disposal of ground water used in connection with producing, reducing, smelting, and milling metallic ores and industrial minerals or that displaced from an aquifer by the storage of other mineral resources; and (e) the management, discharge, or reinjection of ground water produced in association with a coal bed methane well in accordance with **82-11-175**(2)(b) through (2)(d). (2) The department at any time may hold a hearing on its own motion or upon petition signed by a representative body of users of ground water in any area or subarea to determine whether the water supply within that area or subarea is used in compliance with this part.		
Constructing monitoring well	ARM 36.21.802 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=36%2E21%2E802 Rule Title: EXCLUSIONS Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: BOARD OF WATER WELL CONTRACTORS Subchapter: Monitoring Well Construction Standards **36.21.802** EXCLUSIONS Exclusions from these construction standards include the following wells: (1) recovery wells; (2) all wells less than 10 feet deep; (3) vapor detection wells that do not penetrate the water table; (4) lysimeters; (5) neutron tubes; (6) injection wells for the oil and gas industry; (7) holes drilled for non-hydrologic geotechnical information; (8) piezometers and observation wells in dams; (9) monitoring wells installed under the authority of another governmental agency where the construction standards of that agency are more stringent than these rules; and (10) special cases, with prior approval of the board.	☑Applicable* *This provision would apply to the construction of new monitoring wells but does not apply to and is not relevant or appropriate for existing monitoring wells at the Site.	Exclusions re specific requirements for constructing monitoring well
Constructing monitoring well	ARM 36.21.804 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=36%2E21%2E804 Rule Title: MONITOR WELL CONSTRUCTION MATERIALS Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: BOARD OF WATER WELL CONTRACTORS Subchapter: Monitoring Well Construction Standards **36.21.804** MONITOR WELL CONSTRUCTION MATERIALS (1) The well screen configuration, construction, and type of material used should be based on the in-field environmental and physical conditions. (2) Drilling fluids which will contaminate the aquifer shall not be used.	☑Applicable* *This provision would apply to the construction of new monitoring wells or maintenance or upgrades to existing wells but does not otherwise apply to and is not relevant or appropriate for	Provides for specific requirements for constructing monitoring wells

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	(3) In areas of known contamination, materials which will not corrode in the environment in which they are placed shall be used. (4) The well screen and well casing shall be new and be of sufficient structural strength to protect the integrity of the well.	existing monitoring wells at the Site.	
Constructing monitoring well	ARM 36.21.805 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=36%2E21%2E805 Rule Title: SEAL/MATERIALS Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: BOARD OF WATER WELL CONTRACTORS Subchapter: Monitoring Well Construction Standards 36.21.805 SEAL/MATERIALS (1) The intent of this rule is to provide protection to the ground water at least equal to the soil or rock profile penetrated by the borehole or excavation. More stringent standards set by other local, state, or federal agencies shall be followed when applicable. (2) Acceptable seals for rotary or dug holes [air, fluid, auger (solid and hollowstem) , backhoe] include: (a) above the water table: (i) neat cement grout or Portland cement concrete, (ii) bentonite clay grout, (iii) cuttings slurry grout, (iv) compacted clay cuttings, (v) pre-wetted granular or powdered bentonite, (vi) compacted asphaltic concrete, (vii) other materials or methods with board approval; (b) below the water table: (i) neat cement grout, tremied or pumped, (ii) bentonite clay grout, tremied or pumped, (iii) cuttings slurry grout, tremied or pumped, (iv) bentonite pellets or chips, (v) other materials or methods with board approval. (3) For driven wells acceptable seals are granular or powdered bentonite. (4) Jetted methods are not allowed for monitoring well use without board approval.	☑Applicable* *This provision would apply to the construction of new monitoring wells or maintenance or upgrades to existing wells but does not otherwise apply to and is not relevant and appropriate for existing monitoring wells at the Site.	Provides for specific requirements for constructing monitoring wells
Constructing monitoring well	ARM 36.21.806 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=36%2E21%2E806 Rule Title: INSTALLATION OF SEALS Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: BOARD OF WATER WELL CONTRACTORS Subchapter: Monitoring Well Construction Standards 36.21.806 INSTALLATION OF SEALS	☑Applicable* *This provision would apply to the construction of new monitoring wells or maintenance or upgrades to existing wells but does not otherwise apply to and is not relevant and appropriate for	Provides for specific requirements for constructing monitoring wells

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Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	(1) In installing and developing a monitoring well, care shall be taken to preserve the natural barriers to groundwater movement between aquifers. All sealing shall be performed by adding the mixture from the bottom of the space to be sealed toward the surface in one continuous operation, except for driven wells. (2) The minimum sealing material thickness shall be 1 1/2 inches around the outside of the casing on all sides, except for driven wells. (3) For driven wells, granular or powdered bentonite shall be fed alongside the casing. (4) Seal material shall extend down to within five feet of the zone being monitored. In sand and gravel formations, a minimum of 10 feet of surface seal shall be used, except when the zone of monitoring is higher. (5) If the borehole will be advanced through a confining bed immediately below a contaminated aquifer, a casing shall be sealed into the top of the confining bed prior to advancing the borehole through the confining bed. All contaminated tools, drilling fluids, and down-hole equipment shall be cleaned or treated prior to advancing the borehole through the confining bed. (6) A monitoring well encountering an artesian condition shall be sealed and controlled in the same manner as an artesian water well (ARM 36.21.658).	existing monitoring wells at the Site.	
Constructing monitoring well	ARM 36.21.807 *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=36%2E21%2E807 Rule Title: PREVENTION OF CONTAMINATION BY EQUIPMENT Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: BOARD OF WATER WELL CONTRACTORS Subchapter: Monitoring Well Construction Standards **36.21.807** PREVENTION OF CONTAMINATION BY EQUIPMENT (1) Preventive measures shall be performed to ensure against contamination from equipment used to install or sample monitoring wells. Particular care must be exercised when equipment used to install or sample monitoring wells in contaminated environments is subsequently used to install production wells for domestic use. (2) When practicable or feasible, monitoring well installation should proceed from areas with no or low levels of contamination to areas with higher levels of contamination. (3) If contamination is detected during installation of a monitoring well, down-hole equipment should be decontaminated before use on another well or at another site. Appropriate methods of cleaning or decontamination will depend upon the level and type of contaminants, but may include steam cleaning, rinsing with uncontaminated water, or thorough cleaning with surfactants and deionized water. (4) Contamination of down-hole equipment on the drill rig itself by hazardous materials requires thorough cleaning to prevent transport of hazardous contaminants to other locations. On-site decontamination may be necessary under particularly hazardous conditions.	☑Applicable* *This provision would apply to the construction of new monitoring wells or maintenance or upgrades to existing wells but does not otherwise apply to and is not relevant and appropriate for existing monitoring wells at the Site.	Provides for specific requirements for constructing monitoring wells
Constructing monitoring well	ARM 36.21.808 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=36%2E21%2E808 Rule Title: SITE PROTECTION AND SECURITY Department: NATURAL RESOURCES AND CONSERVATION, DEPARTMENT OF Chapter: BOARD OF WATER WELL CONTRACTORS Subchapter: Monitoring Well Construction Standards **36.21.808** SITE PROTECTION AND SECURITY (1) The top of the well shall be fitted with a tight fitting slip cap, threaded plug or cap, or locking cap. Monitoring wells within the radius of influence of a well used as a domestic supply well and hydraulically connected to the aquifer from which the well is drawing water shall have a locking cap or be surrounded by a fenced controlled enclosure.	☑Applicable* *This provision would apply to the construction of new monitoring wells or maintenance or upgrades to existing wells but does not otherwise apply to and is not relevant	Provides for specific requirements for constructing monitoring wells

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	(2) The following are suggested methods for site protection: (a) If the well is cased with metal and completed above the ground surface, a lockable watertight cap may be welded to the top of the casing. (b) If the well is not cased with metal and completed above the ground surface, a metal protective casing may be installed around the well. The protective casing may extend at least six inches above the top of the well casing and at least two feet into the ground. A lockable cap may be welded to the top of the protective casing. (c) If the well is completed below ground surface, a lockable "water-meter cover," or equivalent, may be installed around the well. The cover must be designed to withstand the maximum expected loadings. A watertight seal on the casing itself shall be installed to prevent the inflow of surface water. Drains may be provided, when feasible, to keep water out of the well and below the well cap. (3) The well(s) completed above ground may be protected from damage by one of the following suggested methods: (a) Three metal posts at least three inches in diameter may be installed in a triangular array around the casing. Each post may extend at least three feet above and below the ground surface. (b) A reinforced concrete pad may be installed to prevent freeze/thaw cracking of the surface seal. When a concrete pad is used, the annular seal shall be contiguous to the concrete pad. (c) Other methods agreed upon by the well owner and the monitoring well constructor may be used. (4) The final surface should be sloped away from the monitoring well. If slabs or pavements prevent this, the surface should be sealed with at least four inches of Portland cement or asphaltic concrete. A surface condition which allows surface runoff to run down the side of the casing or borehole is unacceptable and shall be repaired.	and appropriate for existing monitoring wells at the Site.	
Abandoning monitoring well	ARM 36.21.810 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=36%2E21%2E810 Rule Title: ABANDONMENT Department: NATURAL RESOURCES AND CONSERVATION Chapter: BOARD OF WATER WELL CONTRACTORS Subchapter: Monitoring Well Construction Standards **36.21.810** ABANDONMENT (1) Wells which have not been monitored for more than three years shall be deemed abandoned unless written permission is obtained from the board to maintain the well. (2) Monitoring wells that have outlived their useful purpose shall be abandoned by one of the following methods: (a) if the casing and screen are left in place, the casing and screen shall be sealed from the bottom up by the following methods: (i) using a pump and hose or tremie pipe to conduct the sealing material to the bottom of the well; or (ii) by filling the casing and screen with bentonite pellets or chips placed in a manner that will prevent bridging. Metal casings shall be cut off three feet below the ground surface and the last three feet backfilled with naturally occurring soils; (b) the department recommends that the casing be removed in all possible instances. If the casing and/or screen are removed, the hole shall be filled with sealing material, concrete, or bentonite pellets or chips from the bottom up, as the casing and/or screen is removed. From six to three feet from the surface, bentonite shall be added to the well. The last three feet shall be filled with naturally occurring soils; (c) the sealing material shall be bentonite pellets or chips, bentonite clay grout, neat cement grout, or concrete. The material may contain nonbiodegradeable fluidizing admixtures, provided they will not contaminate the groundwater. Sealing materials which settle shall be topped to provide a continuous column of grout to within three feet of the surface; or (d) other methods for abandonment with prior board approval. (3) For flowing wells, the abandonment procedures outlined in ARM 36.21.671 shall apply. (4) A properly abandoned well shall not produce water nor serve as a channel for movement of water.	☑Applicable *This provision applies to abandonment of any direct push borings installed for in situ enhancements as well as future abandonment of monitoring wells	Provides for specifies requirements for abandoning monitoring wells

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	(5) A water well log report, fully describing all abandonment procedures, shall be submitted to the Ground Water Information Center (GWIC) of the MBMG within 60 days of abandoning the well.		
Regulation | Air			
On-site construction activity which causes settlement of particulate matter (dust)	ARM 17.8.204 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E8%2E204 Rule Title: AMBIENT AIR MONITORING Department: ENVIRONMENTAL QUALITY Chapter: AIR QUALITY Subchapter: Ambient Air Quality **17.8.204** AMBIENT AIR MONITORING (1) The requirements of this rule apply to any ambient air monitoring performed by the department or any other entity that is: (a) required by this chapter; (b) used to demonstrate compliance with this chapter; (c) submitted in an application for, or to comply with a condition of, a permit under this chapter; or (d) used to satisfy any applicable requirement of Title 75, chapter 2, MCA, or the federal Clean Air Act, 42 USC 7401 through 7671g, or implementing regulations, for which the department has oversight. (2) Any entity performing ambient air monitoring within the state of Montana for a purpose listed in (1) shall perform it according to a Quality Assurance Project Plan (QAPP) prepared to satisfy the applicable requirements of 40 CFR Parts 50, 53, and 58. If the ambient air monitoring is to be performed to comply with subchapter 8 of this chapter, an entity shall also consider the EPA Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD), EPA-450/4-87-007 (May 1987). (3) If monitoring for a purpose in (1) is performed by: (a) the department, it must be performed in compliance with the Montana Ambient Air Monitoring Program Quality Assurance Project Plan; or (b) any other entity, it must be performed in compliance with a project-specific QAPP that has been submitted to and approved by the department. (4) The department shall notify the entity in writing of approval, conditional approval, or disapproval within 60 days after receiving a project-specific QAPP required by (3)(b). If the department receives additional information in response to a notice of conditional approval or disapproval, the 60-day review period begins again. (5) The department may invalidate, in whole or in part, ambient air monitoring data that was not obtained in compliance with this rule. Invalidated data may not be used for the purposes listed in (1).	☑Applicable* *Intended to be met through development of a construction quality assurance plan that identifies appropriate BMPs for managing fugitive dust	Prohibits causing or contributing to concentrations of particulate matter in the ambient air such that the mass of settle particulate matter exceeds a 30 day average: 10 gm/m2, 30 day average, not to be exceeded. A measurement method is also provided
On-site construction activity which causes settlement of particulate matter	ARM 17.8.220 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E8%2E220 Rule Title: AMBIENT AIR QUALITY STANDARD FOR SETTLED PARTICULATE MATTER Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: AIR QUALITY Subchapter: Ambient Air Quality **17.8.220** AMBIENT AIR QUALITY STANDARD FOR SETTLED PARTICULATE MATTER	☑Applicable* *Intended to be met through development of a construction quality assurance plan that identifies appropriate BMPs	Provides that no person shall cause or contribute to concentrations of particulate matter in the ambient air such that the mass of settled particulate matter exceeds a 30-day average of 10 grams per square meter (gm/m2).

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Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	(1) No person shall cause or contribute to concentrations of particulate matter in the ambient air such that the mass of settled particulate matter exceeds the following standard: (a) thirty-day average: 10 gm/m^2, 30-day average, not to be exceeded. (2) Measurement method: For determining compliance with this rule, settled particulate matter shall be measured by the dust fall method, as more fully described in "Methods of Air Sampling and Analysis, Second Edition" (1977), Method No. 21101-0170T, or by an approved equivalent method.	for managing fugitive dust	A measurement method is also provided
On-site construction activity which causes settlement of particulate matter affecting visibility	ARM 17.8.221 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E8%2E221 Rule Title: AMBIENT AIR QUALITY STANDARD FOR SETTLED PARTICULATE MATTER Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: AIR QUALITY Subchapter: Ambient Air Quality **17.8.221** AMBIENT AIR QUALITY STANDARD FOR VISIBILITY (1) No person shall cause or contribute to concentrations of particulate matter such that the scattering coefficient of particulate matter in the ambient air exceeds the following standard: (a) annual average: 3 x 10^{-5} per meter, annual average, not to be exceeded. (2) The provisions of (1) are applicable only in Class I areas as are designated under the Montana Clean Air Act rules, Prevention of Significant Deterioration of Air Quality, (ARM Title 17, chapter 8, subchapter 8) on the effective date of this rule. Areas redesignated Class I subsequent to the effective date of this rule shall be subject to the provisions of (1) only upon a finding by the board that visibility is an important attribute of such area. (3) Measurement method: For determining compliance with this rule, visibility shall be measured by the integrating nephelometer method, as more fully described in "Methods of Air Sampling and Analysis, Second Edition" (1977) Method No. 11203-03-76 T, as modified by the addition of a heated sample inlet line and green spectral sensitivity; or by an approved equivalent method.	☑Applicable* *Intended to be met through development of a construction quality assurance plan that identifies appropriate BMPs for managing fugitive dust	Provides concentrations of particulate matter in ambient air shall not exceed annual average scattering coefficient of 3 x 10-5 per meter
On-site construction activity which causes settlement of PM-10 particulate matter affecting visibility	ARM 17.8.223 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E8%2E223 Rule Title: AMBIENT AIR QUALITY STANDARD FOR SETTLED PARTICULATE MATTER Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: AIR QUALITY Subchapter: Ambient Air Quality **17.8.223** AMBIENT AIR QUALITY STANDARD FOR PM-10 (1) No person may cause or contribute to concentrations of PM-10 in the ambient air which exceed the following standards: (a) Twenty-four hour average: 150 µg/m^3 of air, 24-hour average, with no more than one expected exceedance per calendar year. (b) Annual average: 50 µg/m^3 of air, expected annual average, not to be exceeded. (2) For the purposes of this rule, expected exceedance and expected annual average shall be determined in accordance with 40 CFR Part 50, Appendix K, incorporated by reference in ARM 17.8.202.	☑Applicable* *Intended to be met through development of a construction quality assurance plan that identifies appropriate BMPs for managing fugitive dust	Provides PM-10 concentrations in ambient air shall not exceed a 24-hour average of 150 ug/m3 of air and an annual average of 50 ug/m3 of air

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	(3) For determining compliance with this rule, PM-10 shall be measured by an applicable reference method based on 40 CFR Part 50, Appendix J, and designated in accordance with 40 CFR Part 53 or by an equivalent method designated in accordance with 40 CFR Part 53, all incorporated by reference in ARM 17.8.202.		
Various activities resulting in emissions of airborne particulate	ARM 17.8.308 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E8%2E308 Rule Title: PARTICULATE MATTER, AIRBORNE Department: ENVIRONMENTAL QUALITY Chapter: AIR QUALITY Subchapter: Emission Standards **17.8.308** PARTICULATE MATTER, AIRBORNE (1) No person shall cause or authorize the production, handling, transportation, or storage of any material unless reasonable precautions to control emissions of airborne particulate matter are taken. Such emissions of airborne particulate matter from any stationary source shall not exhibit an opacity of 20% or greater averaged over six consecutive minutes, except for emission of airborne particulate matter originating from any transfer ladle or operation engaged in the transfer of molten metal which was installed or operating prior to November 23, 1968. (2) No person shall cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter. (3) No person shall operate a construction site or demolition project unless reasonable precautions are taken to control emissions of airborne particulate matter. Such emissions of airborne particulate matter from any stationary source shall not exhibit an opacity of 20% or greater averaged over six consecutive minutes. (4) Within any area designated nonattainment in 40 CFR 81.327 for PM, any person who owns or operates: (a) any existing source of airborne particulate matter shall apply reasonably available control technology (RACT); (b) any new source of airborne particulate matter that has a potential to emit less than 100 tons per year of particulate matter shall apply best available control technology (BACT); (c) any new source of airborne particulate matter that has a potential to emit more than 100 tons per year of particulate matter shall apply lowest achievable emission rate (LAER). (5) The provisions of this rule shall not apply to emissions of airborne particulate matter originating from: (a) any agricultural activity or equipment that is associated with the use of agricultural land or the planting, production, processing, harvesting, or storage of agricultural crops by an agricultural producer and that is not subject to the requirements of 42 USC 7475, 7503, or 7661, as set forth in 75-2-111(1)(a), MCA; or (b) a business relating to the activities or equipment referred to in (5)(a) that remains in a single location for less than 12 months and is not subject to the requirements of 42 USC 7475, 7503, or 7661, as set forth in 75-2-111(1)(b), MCA.	☑Applicable* *Intended to be met through development of a construction quality assurance plan that identifies appropriate BMPs for managing fugitive dust	Provides that no person shall cause or authorize the production, handling, transportation or storage of any material, or cause or authorize the use of any street, road, or parking lot, or operate a construction facility or demolition project, unless reasonable precautions to control emissions of airborne particulate matter are taken. The regulation also states that emissions of airborne particulate matter must be controlled so that they do not "exhibit an opacity of 20 percent or greater average over six consecutive minutes."
Generation of dust emissions during response action activities	ARM 17.8.805 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E8%2E805 Rule Title: AMBIENT AIR CEILINGS Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: AIR QUALITY Subchapter: Prevention of Significant Deterioration of Air Quality **17.8.805** AMBIENT AIR CEILINGS	☑Applicable* *Intended to be met through development of a construction quality assurance plan that identifies appropriate BMPs for managing fugitive dust	Provides ambient air ceilings, and states that no concentrations of a pollutant shall exceed concentrations permitted under the applicable secondary or the primary national ambient air quality standard, whichever concentration is lowest

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	(1) No concentration of a pollutant shall exceed the concentration permitted under either the applicable secondary or primary national ambient air quality standard, whichever concentration is lowest for the pollutant for a period of exposure.		for the pollutant for a period of exposure
Regulation | Mining - Air			
Generating dust emissions during response action activities	ARM 17.24.761 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E24%2E761 Rule Title: AIR RESOURCES PROTECTION Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: RECLAMATION Subchapter: Strip and Underground Mine Reclamation Act: Topsoiling, Revegetation, and Protection of Wildlife and Air Resources **17.24.761** AIR RESOURCES PROTECTION (1) Each operator shall employ **fugitive dust control measures** as an integral part of site preparation, coal mining and reclamation operations in accordance with 82-4-231 (10) (m) , MCA, the operator's air quality permit, and applicable federal and state air quality standards. (2) Air monitoring equipment must be installed and monitoring must be conducted in accordance with the air monitoring plan required under ARM 17.24.311 and approved by the department.	☑Relevant and Appropriate* *Intended to be met through development of a construction quality assurance plan that identifies appropriate BMPs for managing fugitive dust	Specifies a range of measures for controlling fugitive dust emissions during mining and reclamation activities. Some of the measures could be considered relevant and appropriate to control fugitive dust emissions in connection with excavation, earth moving and transportation conducted as part of the response action(s) at the facility. Such measures include, for example, paving, watering, chemically stabilizing, or frequently compacting and scraping roads ,promptly removing rock, soil or other dust-forming debris from roads, restricting vehicle speeds, revegetating, mulching, or otherwise stabilizing the surface of areas adjoining roads, restricting unauthorized vehicle travel, minimizing the area of disturbed land, and promptly revegetating regraded lands

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Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
Transporting solid waste to avoid discharge, dumping, spilling or leaking from transport vehicle	ARM 17.50.523 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E50%2E523 Rule Title: TRANSPORTATION Department: ENVIRONMENTAL QUALITY Chapter: SOLID WASTE MANAGEMENT Subchapter: Refuse Disposal 17.50.523 TRANSPORTATION (1) Solid waste must be transported in such a manner so as to prevent its discharge, dumping, spilling, or leaking from the transport vehicle. (2) Waste haulers transporting oilfield exploration and production waste must cover and secure loads and keep loads covered and secure while in transit in a manner that prevents discharge, dumping, spilling, or leaking from the transport vehicle.	☑Applicable* *This provision applies to the disposal of any packaging associated with in situ enhancements and disposal of aqueous phase samples by laboratory once analyzed	Provides that solid waste must be transported in such a manner as to prevent its discharge, dumping, spilling, or leaking from the transport vehicle
Transporting solid waste	Section 75-10-212, MCA *Available at*: https://leg.mt.gov/bills/mca/title_0750/chapter_0100/part_0020/section_0120/0750-0100-0020-0120.html TITLE 75. ENVIRONMENTAL PROTECTION CHAPTER 10. WASTE AND LITTER CONTROL Part 2. Licensing of Refuse Disposal and Transportation Montana Solid Waste Management Act **75-10-212. Disposal in unauthorized area prohibited -- exception.** (1) A person may not dispose of solid waste except as permitted under this part. (2) It is unlawful to dump or leave any garbage, dead animal, or other debris or refuse: (a) in or upon any highway, road, street, or alley of this state; (b) in or upon any public property, highway, street, or alley under the control of the state of Montana or any political subdivision of the state or any officer or agent or department of the state or political subdivision of the state; (c) within 200 yards of a public highway, road, street, or alley or public property; (d) on privately owned property where hunting, fishing, or other recreation is permitted; however, this subsection does not apply to the owner, the owner's agents, or those disposing of debris or refuse with the owner's consent. (3) A person in violation of this section is absolutely liable, as provided in **45-2-104**, and is subject to the civil penalties provided in **75-10-233**.	☑Applicable *Any solid waste generated during in situ enhancements, monitoring well installation, sampling and other maintenance activities shall be properly disposed of if transported off site	Prohibits dumping or leaving any debris or refuse upon or within 200 yards of any highway, road, street, or alley of the State or other public property, or on privately owned property where hunting, fishing, or other recreation is permitted. However, the restrictions relating to privately owned property does not apply to the owner, his agents, or those disposing of debris or refuse with the owner's consent.
Statute | Montana Hazardous Waste Act			
Disposing used oil or hazardous waste unlawfully	Section 75-10-422, MCA *Available at*: https://leg.mt.gov/bills/mca/title_0750/chapter_0100/part_0040/section_0220/0750-0100-0040-0220.html TITLE 75. ENVIRONMENTAL PROTECTION	☑Applicable* *Any used oil or hazardous waste generated during in	Prohibits the unlawful disposal of hazardous waste

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) Idaho Pole Company Focused Feasibility Study			
Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	CHAPTER 10. WASTE AND LITTER CONTROL Part 4. Hazardous Waste Management **75-10-422. Unlawful disposal.** It is unlawful to dispose of used oil or hazardous waste, as defined in this part or by rule, without a permit or, if a permit is not required under this part or rules adopted under this part, by any other means not authorized by law.	situ enhancements (e.g., packaging), monitoring well installation (e.g., soil cuttings), sampling (e.g., investigative derived waste) and other maintenance activities shall be properly disposed of if transported off site	
Regulation | Montana Hazardous Waste Act			
Handling and disposing of hazardous waste	ARM 17.53.501 *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=17.53.501 Rule Title: ADOPTION OF FEDERAL PROCEDURES FOR IDENTIFICATION AND LISTING OF HAZARDOUS WASTE (40 CFR 261) Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: HAZARDOUS WASTE Subchapter: Identification and Listing of Hazardous Waste **17.53.501** ADOPTION OF FEDERAL PROCEDURES FOR IDENTIFICATION AND LISTING OF HAZARDOUS WASTE (40 CFR 261) (1) Except as provided otherwise in ARM 17.53.502, the department hereby adopts and incorporates by reference 40 CFR 261, pertaining to identification, characteristics, listing, and criteria for identification and listing of wastes regulated as hazardous waste.	☑Applicable* *The substantive requirements of this provision would apply to hazardous waste generated during remedial action activities such as soil cuttings generated during monitoring well installation	Adopts the equivalent of RCRA regulations at 40 C.F.R. Part 261, establishing standards for the identification and listing of hazardous wastes, including standards for recyclable materials and standards for empty containers, which certain State exceptions and additions.
Handling and disposing of hazardous waste	ARM 17.53.502 *Available at*: http://www.mtrules.org/gateway/ruleno.asp?RN=17.53.502 Rule Title: EXCEPTIONS AND ADDITIONS TO ADOPTION OF FEDERAL STANDARDS FOR IDENTIFICATION AND LISTING OF HAZARDOUS WASTE Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: HAZARDOUS WASTE Subchapter: Identification and Listing of Hazardous Waste **17.53.502** EXCEPTIONS AND ADDITIONS TO ADOPTION OF FEDERAL STANDARDS FOR IDENTIFICATION AND LISTING OF HAZARDOUS WASTE	☑Applicable* *The substantive requirements of this provision would apply to hazardous waste generated during remedial action activities such as soil cuttings generated during	Adopts the equivalent to RCRA regulations at 40 C.F.R. Part 262, establishing standards that apply to generators of hazardous waste, including standards pertaining to the accumulation of hazardous wastes, with certain State exceptions and additions

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) Idaho Pole Company Focused Feasibility Study			
Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	(1) The following language is substituted for the language in 40 CFR 261.2(f) , adopted and incorporated by reference in ARM 17.53.501: "Respondents in actions to enforce this chapter who claim that a certain material is not a waste, or is conditionally exempt from regulation, must demonstrate that there is a known market or disposition for the material, and that the respondent meets the terms of the exclusion or exemption. In doing so, the respondent must provide appropriate documentation (such as contracts showing that a second person uses the material as an ingredient in a production process) to demonstrate that the material is not a waste, or is exempt from regulation. In addition, owners or operators of facilities claiming that they actually are recycling materials must show that they have the necessary equipment to do so." (2) In 40 CFR 261.4(e) (2) (vi) , pertaining to treatability study samples and generator reporting, "annual" is substituted for "biennial". (3) In 40 CFR 261.4(e) (3) (iii) the words "in the Region where the sample is collected" are not adopted and incorporated by reference. (4) In 40 CFR 261.4(f) (1) , pertaining to treatability studies, the phrase "director of the Montana department of environmental quality" is substituted for "Regional Administrator, or State Director (if located in an authorized State) ". (5) In 40 CFR 261.21(a) (3) , "a flammable gas as defined in 49 CFR 173.115(a) " is substituted for "an ignitable compressed gas as defined in 49 CFR 173.300". (6) In 40 CFR 261.21(a) (4) , "an oxidizer as defined in 49 CFR 173.127(a) " is substituted for "an oxidizer as defined in 49 CFR 173.151". (7) "It is a forbidden explosive as defined in 49 CFR 173.54; or would have been a Class A or B explosive as defined in 49 CFR 173.52 and 53." is substituted for 40 CFR 261.23(a) (8) . (8) Appendix IX of 40 CFR 261, pertaining to wastes excluded under 40 CFR 260.20 and 260.22, is not adopted and incorporated by reference.	monitoring well installation	
	ARM 17.53.601 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E53%2E601 Rule Title: ADOPTION OF FEDERAL STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE (40 CFR 262) Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: HAZARDOUS WASTE Subchapter: Standards Applicable to Generators of Hazardous Waste **17.53.601** ADOPTION OF FEDERAL STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE (40 CFR 262) (1) Except as provided otherwise in ARM 17.53.602, the department hereby adopts and incorporates by reference 40 CFR 262, pertaining to hazardous waste generator standards.	☑Applicable* The substantive requirements of this provision would apply to hazardous waste generated during remedial action activities such as soil cuttings generated during monitoring well installation	See immediately above
	ARM 17.53.602 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E53%2E602 Rule Title: EXCEPTIONS AND ADDITIONS TO ADOPTION OF FEDERAL STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: HAZARDOUS WASTE Subchapter: Standards Applicable to Generators of Hazardous Waste	☑Applicable *The substantive requirements of this provision would apply to hazardous waste generated during remedial action activities such as soil cuttings	See immediately above

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) Idaho Pole Company Focused Feasibility Study			
Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	17.53.602 EXCEPTIONS AND ADDITIONS TO ADOPTION OF FEDERAL STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE (1) In 40 CFR 262.11(c) (1) , pertaining to hazardous waste determination, the phrase "or according to an equivalent method approved by the Administrator under 40 CFR 260.21" is not adopted and incorporated by reference. (2) In 40 CFR 262.40(b) , pertaining to generator recordkeeping, "annual" is substituted for "biennial". (3) ARM 17.53.603 is substituted for 40 CFR 262.41, pertaining to biennial reporting. (4) In 40 CFR 262.42(a) (2) and (b) , pertaining to exception reporting, the words "in the Region in which the generator is located" are not adopted and incorporated by reference. (5) ARM 17.53.604 is substituted for 40 CFR 262.43, pertaining to additional reporting requirements. (6) In 40 CFR 262.51, 262.52, 262.53, 262.54, 262.56, and 262.57, pertaining to exports of hazardous waste, references to "EPA" are retained. (7) Exception reports required from primary exporters pursuant to 40 CFR 262.55 must be filed with EPA and the department. (8) Annual reports required from primary exporters pursuant to 40 CFR 262.56 must be filed with EPA and the department. (9) In 40 CFR 262.57(b) , pertaining to export record keeping, the reference to the "Administrator" is retained. The department may also require extensions of record retention times for hazardous waste export records. (10) Conditionally exempt small quantity generators are not subject to the requirements of ARM 17.53.603. (11) In 40 CFR 262, Appendix, Item 19, pertaining to the Uniform Hazardous Waste Manifest and instructions, the second paragraph and the list of EPA administrators is not adopted and incorporated by reference. Also, "Montana" is substituted for "authorized States (i.e., those States that have received authorization from the U.S. EPA to administer the hazardous waste program) ".	generated during monitoring well installation.	
Transporting hazardous waste	ARM 17.53.701 citing 40 C.F.R. part 263 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E53%2E701 Rule Title: ADOPTION OF FEDERAL STANDARDS APPLICABLE TO TRANSPORTERS OF HAZARDOUS WASTE (40 CFR 263) Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: HAZARDOUS WASTE Subchapter: Standards Applicable to Transporters of Hazardous Waste 17.53.701 ADOPTION OF FEDERAL STANDARDS APPLICABLE TO TRANSPORTERS OF HAZARDOUS WASTE (40 CFR 263) (1) Except as provided otherwise in ARM 17.53.701, the department hereby adopts and incorporates by reference 40 CFR 263, pertaining to requirements for transporters of hazardous waste.	☑Applicable* *The substantive requirements of this provision would apply to hazardous waste generated during remedial action activities such as soil cuttings generated during monitoring well installation that require off-site disposal	See immediately above
Transporting hazardous waste	ARM 17.53.702 *Available at*: http://www.mtrules.org/gateway/RuleNo.asp?RN=17%2E53%2E702 Rule Title: EXCEPTIONS AND ADDITIONS TO ADOPTION OF FEDERAL STANDARDS APPLICABLE TO TRANSPORTERS OF HAZARDOUS WASTE Department: ENVIRONMENTAL QUALITY, DEPARTMENT OF Chapter: HAZARDOUS WASTE	☑Applicable* *The substantive requirements of this provision would apply to hazardous waste generated during remedial	See immediately above

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
Idaho Pole Company Focused Feasibility Study

Site-Specific Characteristics	Citation(s)	Prerequisite	Requirements
	Subchapter: Standards Applicable to Transporters of Hazardous Waste 17.53.702 EXCEPTIONS AND ADDITIONS TO ADOPTION OF FEDERAL STANDARDS APPLICABLE TO TRANSPORTERS OF HAZARDOUS WASTE (1) All references to "EPA" and "Administrator" are retained, except for 40 CFR 263.11(a) and (b), and 40 CFR 263.22(e) where "administrator" should be replaced with "director of the Montana department of environmental quality". (2) In addition to the transfer facility requirements of 40 CFR 263.12, a transfer facility is subject to ARM 17.53.704, 17.53.706, and 17.53.707. (3) For at least three years after the date the hazardous waste was accepted by the initial transporter, copies of the manifest, as required under 40 CFR 263.22(a) , must be maintained on file at the transfer facility location for all hazardous waste shipments that are transported to a transfer facility. (4) In addition to the notices and reports required by 40 CFR 263.30 in the event of discharges of hazardous waste during transportation, the transporter shall also notify the department by immediately contacting the Montana hazardous materials emergency response system ((406) 324-4777) .	action activities such as soil cuttings generated during monitoring well installation that require off-site disposal	
Statute | Weed Control			
Propagation of noxious weeds	Section 7-22-2116(1), MCA *Available at*: https://leg.mt.gov/bills/mca/title_0070/chapter_0220/part_0210/section_0160/0070-0220-0210-0160.html TITLE 7. LOCAL GOVERNMENT CHAPTER 22. WEED AND PEST CONTROL Part 21. County Weed Control | Unlawful To Permit Noxious Weeds To Propagate -- Notice Required In Sale **7-22-2116. Unlawful to permit noxious weeds to propagate -- notice required in sale.** (1) It is unlawful for any person to permit any noxious weed to propagate or go to seed on the person's land, except that any person who adheres to the noxious weed management program of the person's weed management district or who has entered into and is in compliance with a noxious weed management agreement is considered to be in compliance with this section. (2) When property is offered for sale, the person who owns the property shall notify the owner's agent and the purchaser of: (a) the existence of noxious weed infestations on the property offered for sale; and (b) the existence of a noxious weed management program or a noxious weed management agreement as provided in subsection (1).	☑Applicable* *These requirements would apply to the reclamation of an area disturbed by grading, excavation, or similar actions, and require the revegetation of the area.	Prohibits allowing noxious weeds to propagate
Propagation of noxious weeds	Section 7-22-2152, MCA *Available at*: https://leg.mt.gov/bills/mca/title_0070/chapter_0220/part_0210/section_0520/0070-0220-0210-0520.html TITLE 7. LOCAL GOVERNMENT CHAPTER 22. WEED AND PEST CONTROL Part 21. County Weed Control Revegetation Of Rights-Of-Way And Areas That Have Potential For Noxious Weed Infestation **7-22-2152. Revegetation of rights-of-way and areas that have potential for noxious weed infestation.** (1) Any person or state agency proposing a mine, a major facility under Title 75, chapter 20, an electric, communication, gas, or liquid transmission	☑Applicable *These requirements would apply to the reclamation of an area disturbed by grading, excavation, or similar actions, and require the	Provides for preparation and implementation of weed control plan

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) Idaho Pole Company Focused Feasibility Study			
Site-Specific Characteristics	**Citation(s)**	**Prerequisite**	**Requirements**
	line, a solid waste facility, a highway or road, a subdivision, a commercial, industrial, or government development, or any other development that needs state or local approval and that results in the potential for noxious weed infestation within a district shall notify the board at least 15 days prior to the activity. (2) Whenever any person or agency constructs a road, an irrigation or drainage ditch, a pipeline, an electric, communication, gas, or liquid transmission line, or any other development on an easement or right-of-way, the board shall require that the areas be seeded, planted, or otherwise managed to reestablish a cover of beneficial plants. (3) (a) The person or agency committing the action shall submit to the board a written plan specifying the methods to be used to accomplish revegetation at least 15 days prior to the activity. The plan must describe the time and method of seeding, fertilization practices, recommended plant species, use of weed-free seed, and the weed management procedures to be used. (b) The plan is subject to approval by the board, which may require revisions to bring the revegetation plan into compliance with the district weed management plan. The activity for which notice is given may not occur until the plan is approved by the board and signed by the presiding officer of the board and by the person or a representative of the agency responsible for the action. The signed plan constitutes a binding agreement between the board and the person or agency. The plan must be approved, with revisions if necessary, within 10 days of receipt by the board.	revegetation of the area.	
Regulation | Weed Control			
Controlling specified noxious weeds	ARMS 4.5.206-.210 (Series citation) Available at: http://www.mtrules.org/gateway/ruleno.asp?RN=4.5.206 Department: AGRICULTURE Chapter: NOXIOUS WEED MANAGEMENT Subchapter: Designation of Noxious Weeds	☑Applicable* *Applicable for monitoring wells installed and monitored where noxious weeds may be dispersed due to disturbance	Provides for weed eradication where specified noxious weeds exist

July 2022

Appendix D
Proof of Prepayment

For Administrative Settlement Agreement and Order on Consent
for In Situ Amendments in Support of Focused Feasibility Study
Idaho Pole Company Superfund Site
Bozeman, Montana

PO Box 358
Freeport, Illinois 61032
(815) 650-2230

VIA EMAIL: les.lonning@gmail.com

July 11, 2022

Mr. Les Lonning
Idaho Pole Company
3325 Meridian Avenue E. Suite #4
Edgewood, WA 98371
Tel: (253) 878 – 4647

Subject: **Pre-Payment Confirmation Letter**
Provect-OX®, Provect-OX2™ and Provect-IR® Treatment Program
Idaho Pole Site – Bozeman, Montana
Provectus Proposal No. PEP22-0035

Dear Les:

We are in receipt of Idaho Poles' $300,000 prepayment for work to be done in accordance with the ASOC and work plan for the Idaho Pole facility in Bozeman Montana.

On behalf of Provectus, I thank you for your business related to our products, services, and technologies. Please contact me by telephone at (480) 670-7278 or by email at andy.lowy@provectusenv.com if you have any questions regarding this pre-payment.

Yours truly,

Provectus Environmental Products, Inc.

via e-mail

Andy Lowy – *Technical Sales*

Hydrometrics, Inc.
Consulting Scientists and Engineers

5602 Hesper Rd.
Billings, MT 59106-3236
(406) 656-1172
Fax: (406) 656-8912
www.hydrometrics.com

July 11, 2022

Mr. Les Lonning
Idaho Pole Company
3325 Meridian Ave E Suite #4
Edgewood, WA 98371

RE: Prepayment for Hydrometrics Oversight of the In Situ Injection Treatment Program – Idaho Pole Site, Bozeman, Mt.

Dear Les,

Hydrometrics is in receipt of $155,905 prepayment for oversight work to be done in accordance with the Administrative Settlement Agreement and Order on Consent (ASAOC) and work plan for the Idaho Pole facility in Bozeman, Montana.

Regards,
Hydrometrics, Inc.

Heidi Kaiser
Project Manager

C: Hydrometrics File 5029

July 2022

Appendix E
Form of the Idaho Pole Co. Financial Assurance Trust Fund

For Administrative Settlement Agreement and Order on Consent
for In Situ Amendments in Support of Focused Feasibility Study
Idaho Pole Company Superfund Site
Bozeman, Montana

TRUST AGREEMENT
Idaho Pole Company
Superfund Site: Bozeman, Montana
Dated: July ___, 2022

This Trust Agreement (the "Agreement") relating to [**insert trustee-provided trust account number**] is entered into as of July ___, 2022 between **Idaho Pole Co.,** a Washington corporation, (the "Grantor"), and **Pacific Portfolio Trust Company,** incorporated in the state of Washington (the "Trustee").

Whereas, the United States Environmental Protection Agency (EPA) and the Grantor have entered into an Administrative Settlement Agreement and Order on Consent for In Situ Amendments in Support of Focused Feasibility Study (hereinafter, the "Settlement Agreement"), dated July ___, 2022, CERCLA Docket No. ___ pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. §§ 9601-9675;

Whereas, the Settlement Agreement requires the Grantor provide assurance that funds will be available as and when needed for performance of the Work required by the Settlement Agreement;

Whereas, in order to provide such financial assurance, Grantor has agreed to establish and fund the trust created by this Agreement; and

Whereas, the Grantor, acting through its duly authorized officers, has selected the Trustee to be the trustee under this Agreement, and the Trustee has agreed to act as trustee hereunder.

Now, therefore, the Grantor and the Trustee agree as follows:

Section 1. Definitions. As used in this Agreement*:*

(a) The term "Agreement" shall have the meaning assigned thereto in the first paragraph of this Agreement.

(b) The term "Beneficiary" shall have the meaning assigned thereto in Section 3 of this Agreement.

(c) The term "CERCLA" shall have the meaning assigned thereto in the second paragraph of this Agreement.

(d) The term "Claim Certificate" shall have the meaning assigned thereto in Section 4(a) of this Agreement.

(e) The term "EPA" shall have the meaning assigned thereto in the second paragraph of this Agreement.

(f) The term "Fund" shall have the meaning assigned thereto in Section 3 of this Agreement.

(g) The term "Grantor" shall have the meaning assigned thereto in the first paragraph of this Agreement, along with any successors or assigns of the Grantor.

(h) The term "Objection Notice" shall have the meaning assigned thereto in Section 4(b) of this Agreement.

(i) The term "Settlement Agreement" shall have the meaning assigned thereto in the second paragraph of this Agreement.

(j) The term "Site" shall have the meaning assigned thereto in Section 2 of this Agreement.

(k) The term "Trust" shall have the meaning assigned thereto in Section 3 of this Agreement.

(l) The term "Trustee" shall mean the trustee identified in the first paragraph of this Agreement, along with any successor trustee appointed pursuant to the terms of this Agreement.

(m) The term "Work" shall have the meaning assigned thereto in the Settlement Agreement.

(n) The term "Work Takeover" shall have the meaning assigned thereto in the Settlement Agreement.

Section 2. Identification of Site and Cost Estimate. This Agreement pertains to costs for Work required at the Idaho Pole Company Superfund Site in Bozeman, Montana (the "Site"), pursuant to the Settlement Agreement.

Section 3. Establishment of Trust Fund. The Grantor and the Trustee hereby establish a trust (the "Trust"), for the benefit of EPA (the "Beneficiary"), to ensure that funds are available to pay for performance of the Work in accordance with the terms of the Settlement Agreement. The Grantor and the Trustee intend that no third party shall have access to monies or other property in the Trust except as expressly provided herein. The Trust is established initially as consisting of cash or cash equivalents in the amount of $3,332,496, which is acceptable to the Trustee and described in Schedule A attached hereto. Such funds, along with any other cash and/or cash equivalents hereafter deposited into the Trust, and together with all earnings and profits thereon, are referred to herein collectively as the "Fund." The Fund shall be held by the Trustee, IN TRUST, as

hereinafter provided. The Trustee shall not be responsible nor shall it undertake any responsibility for the amount or adequacy of, nor any duty to collect from the Grantor, any payments necessary to discharge any liabilities of the Grantor owed to the United States.

Section 4. Payment to Grantor Due to EPA Approved Reduction in Financial Assurance Required Under the Settlement Agreement. The Trustee shall make payments from the Fund in accordance with the following procedures:

(a) In accordance with Paragraph 56 of the Settlement Agreement, from time to time, the Grantor and/or its representatives may request that the Trustee make payment from the Fund to Grantor following Grantor's written request comprised of a Claim Certificate to EPA to reduce the amount of Financial Assurance pursuant to Section 56 of the Settlement Agreement and delivery to the Trustee of EPA's written approval of Grantor's request for reduction in the amount of Financial Assurance in the Fund. Any Claim Certificate must at a minimum: (i) include a certification that the Work performed at the Site in accordance with the Settlement Agreement; (ii) describe the Work that has been performed; (iii) include an estimated cost of the remaining Work plus the 60% Margin; and (iv) specify the amount of funds requested from the Trust. For the Section 4(a)(i) certification, the Grantor must make the following certification: "I certify under penalty of perjury that the Claim Certificate is for Work performed at the Site in accordance with the Settlement Agreement. Based on my inquiry of the contractor who performed this Work, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

(b) The Trustee shall make payment to Grantor of the EPA approved request for reduction of Financial Assurance within five (5) business days of receiving Grantor's request for payment and EPA's written approval of Grantor's request for reduction in the amount of Financial Assurance in the Fund.

(c) If, at any time during the term of this Agreement, EPA implements a "Work Takeover" pursuant to the terms of the Settlement Agreement and intends to direct payment of monies from the Fund to pay for performance of Work during the period of such Work Takeover, EPA shall notify the Trustee in writing of EPA's commencement of such Work Takeover. Upon receiving such written notice from EPA, the Trustee shall thereafter make payments from the Fund only to such person(s) as the EPA may direct in writing from time to time for the sole purpose of providing payment for performance of Work required by the Settlement Agreement. Further, after receiving such written notice from EPA, the Trustee shall not make any disbursements to Grantor for costs of Work taken over by EPA from the Fund at the request of the Grantor except at the express written direction of EPA. If EPA ceases such a Work Takeover in accordance with the terms of the Settlement Agreement, EPA may so notify the Trustee in writing and, upon the Trustee's receipt of such notice, the disbursement procedures specified in Sections 4(a)-(b) above shall be reinstated.

(d) While this Agreement is in effect, disbursements from the Fund are governed exclusively by the express terms of this Agreement.

Section 5. Trustee Management. The Trustee shall invest and reinvest the principal and income of the Fund and keep the Fund invested as a single fund, without distinction between principal and income, in accordance with directions which the Grantor may communicate in writing to the Trustee from time to time, subject, however, to the provisions of this Section. In investing, reinvesting, exchanging, selling, and managing the Fund, the Trustee shall discharge its duties with respect to the Trust solely in the interest of the Beneficiary and with the care, skill, prudence, and diligence under the circumstances then prevailing which persons of prudence, acting in a like capacity and familiar with such matters, would use in the conduct of an enterprise of a like character and with like aims; except that:

(a) securities, notes, and other obligations of any person or entity shall not be acquired or held by the Trustee with monies comprising the Fund, unless they are securities, notes, or other obligations of the United States federal government or any United States state government or as otherwise permitted in writing by EPA;

(b) the Trustee is authorized to invest the Fund in time or demand deposits of the Trustee, to the extent such deposits are insured by an agency of the United States federal or any United States state government; and

(c) the Trustee is authorized to hold cash awaiting investment or distribution uninvested for a reasonable time and without liability for the payment of interest thereon.

Section 6. Commingling and Investment. The Trustee is expressly authorized in its discretion to transfer from time to time any or all of the assets of the Fund to any common, commingled, or collective trust fund created by the Trustee in which the Fund is eligible to participate, subject to all of the provisions hereof and thereof, to be commingled with the assets of other trusts participating therein.

Section 7. Express Powers of Trustee. Without in any way limiting the powers and discretion conferred upon the Trustee by the other provisions of this Agreement or by law, the Trustee is expressly authorized and empowered:

(a) to make, execute, acknowledge, and deliver any and all documents of transfer and conveyance and any and all other instruments that may be necessary or appropriate to carry out the powers herein granted;

(b) to register any securities held in the Fund in its own name or in the name of a nominee and to hold any security in bearer form or in book entry, or to combine certificates representing such securities with certificates of the same issue held by the Trustee in other fiduciary capacities, or to deposit or arrange for the deposit of such

securities in a qualified central depositary even though, when so deposited, such securities may be merged and held in bulk in the name of the nominee of such depositary with other securities deposited therein by another person, or to deposit or arrange for the deposit of any securities issued by the United States federal government or any United States state government, or any agency or instrumentality thereof, with a Federal Reserve bank, but the books and records of the Trustee shall at all times show that all such securities are part of the Fund; and

(c) to deposit any cash in the Fund in interest-bearing accounts maintained or savings certificates issued by the Trustee, in its separate corporate capacity, or in any other banking institution affiliated with the Trustee, to the extent insured by an agency of the United States federal government.

Section 8. Taxes and Expenses. All taxes of any kind that may be assessed or levied against or in respect of the Fund shall be paid from the Fund. All other expenses and charges incurred by the Trustee in connection with the administration of the Fund and this Trust shall be paid by the Grantor.

Section 9. Annual Valuation. The Trustee shall annually, no more than 30 days after the anniversary date of establishment of the Fund, furnish to the Grantor and to the Beneficiary a statement confirming the value of the Trust. The annual valuation shall include an accounting of any fees or expenses levied against the Fund. The Trustee shall also provide such information concerning the Fund and this Trust as EPA may request from time to time.

Section 10. Advice of Counsel. The Trustee may from time to time consult with counsel with respect to any question arising as to the construction of this Agreement or any action to be taken hereunder; provided, however, that any counsel retained by the Trustee for such purposes may not, during the period of its representation of the Trustee, serve as counsel to the Grantor.

Section 11. Trustee Compensation. The Trustee shall be entitled to reasonable compensation for its services as agreed upon in writing with the Grantor and as notified in writing to the Beneficiary; provided, however, that the Trustee shall have minimal duties and shall be entitled to minimal compensation, if any, except for any time periods in which the Trustee is reviewing and processing requests for payment(s) from the Fund to Grantor in connection with EPA approved reductions in the Financial Assurance required by the Settlement Agreement.

Section 12. Trustee and Successor Trustee. The Trustee and any replacement Trustee must not be affiliated with the Grantor. The Trustee may resign or the Grantor may replace the Trustee, but such resignation or replacement shall not be effective until the Grantor has appointed a successor trustee and this successor accepts such appointment. The successor trustee shall have the same powers and duties as those conferred upon the Trustee hereunder. Upon the successor trustee's acceptance of the appointment, the Trustee shall assign, transfer, and pay over to the successor trustee the cash and/or cash equivalents then

constituting the Fund. If for any reason the Grantor cannot or does not act in the event of the resignation of the Trustee, the Trustee may apply to a court of competent jurisdiction for the appointment of a successor trustee or for instructions. The successor trustee shall specify the date on which it assumes administration of the Fund and the Trust in a writing sent to the Grantor, the Beneficiary, and the present Trustee by certified mail no less than 10 days before such change becomes effective. Any expenses incurred by the Trustee as a result of any of the acts contemplated by this Section shall be paid as provided in Section 8.

Section 13. Instructions to the Trustee. All orders, requests, and instructions to the Trustee shall be in writing, signed by such persons as are empowered to act on behalf of the entity sending such orders, requests, and instructions to the Trustee, including those designated in the attached Exhibit B or such other designees as the Grantor may designate by amendment to Exhibit B. The Trustee shall be fully protected in acting without inquiry on such written instructions given in accordance with the terms of this Agreement. The Trustee shall have no duty to act in the absence of such written instructions, except as expressly provided for herein.

Section 14. Amendment of Agreement. This Agreement may be amended by an instrument in writing executed by the Grantor and the Trustee, and with the prior written consent of EPA, or by the Trustee and EPA if the Grantor ceases to exist.

Section 15. Irrevocability and Termination. This Trust shall be irrevocable and shall continue until terminated upon the earlier to occur of (a) the written direction of EPA to terminate, consistent with the terms of the Settlement Agreement; (b) the complete exhaustion of the Fund comprising the Trust as certified in writing by the Trustee to EPA and the Grantor; or (c) EPA issuance of Notice of Completion of Work in accordance with the Settlement Agreement. Upon termination of the Trust pursuant to Section 15(a) or 15(c), all remaining Trust property (if any), less final Trust administration expenses, shall be delivered to the Grantor.

Section 16. Immunity and Indemnification. The Trustee shall not incur personal liability of any nature in connection with any act or omission, made in good faith, in the administration of this Trust, or in carrying out any directions by the Grantor or EPA issued in accordance with this Agreement. The Trustee shall be indemnified and saved harmless by the Grantor from and against any personal liability to which the Trustee may be subjected by reason of any act or conduct made by the Trustee in its official capacity, including all expenses reasonably incurred in its defense in the event the Grantor fails to provide such defense.

Section 17. Choice of Law. This Agreement shall be administered, construed, and enforced according to the laws of the state of Washington.

Section 18. Interpretation. As used in this Agreement, words in the singular include the plural and words in the plural include the singular. The descriptive headings for each Section of this Agreement shall not affect the interpretation or the legal efficacy of

this Agreement.

Section 19. Notices. All notices and other communications given under this Agreement shall be in writing, identify the Site, provide a contact person (and contact information), and be addressed to the parties as follows or to such other address as the parties shall by written notice designate:

(a) If to the Grantor, to Greg D. McFarland, 3325 Meridian Ave. E., Suite 4, Edgewood, WA 98371; (253) 922-4902 or gregm@cdrmgt.com.

(b) If to the Trustee, to Larry Hood, Pacific Portfolio Trust Company, 701 5th Ave., Suite 6850, Seattle, WA 98104; (206) 623-6641 or larry@pacific-portfolio.com.

(c) If to EPA, to:

Roger Hoogerheide
EPA Remedial Project Manager
hoogerheide.roger@epa.gov

Julie Nicholson
EPA Enforcement Specialist
nicholson.julie@epa.gov

Kayleen Castelli
Senior Assistant Regional Counsel
castelli.kayleen@epa.gov

Section 20. Other. The Grantor shall provide a copy of the Settlement Agreement to the Trustee, and the Grantor shall submit an originally signed duplicate of the executed Agreement to EPA.

[SIGNATURES ON FOLLOWING PAGE]

In Witness Whereof, the parties hereto have caused this Agreement to be executed by their respective officers duly authorized and attested as of the date first above written:

FOR THE GRANTOR:

Date: _____ By [signature]: _____
Printed name: Gregory D. McFarland
Title: Co-President

State of Washington
County of _____

On this ____ day of July, 2022, before me personally came Gregory D. McFarland to me known, who, being by me duly sworn, did depose and say that he is Co-President of Idaho Pole Company, the entity described in and which executed the above instrument; and that he signed his name thereto.

_____
[Signature of Notary Public]

FOR THE TRUSTEE:

Date: _____ By [signature]: _____
Printed name: Larry Hood
Title: President and CEO

State of Washington
County of _____

On this ____ day of July, 2022, before me personally came Larry Hood to me known, who, being by me duly sworn, did depose and say that he is President and CEO of Pacific Portfolio Trust Company, the entity described in and which executed the above instrument; and that he signed his name thereto.

_____
[Signature of Notary Public]

Schedule A
Initial Trust Funding

DATE	FUNDING VALUE FOR WORK
[**Insert relevant initial date (e.g., within 30 days of the Effective Date of the settlement)**]	[**Insert initial funding amount**]