IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NORTH DAKOTA
WESTERN DIVISION

Civil Action No. 22-00089-DLH-CRH

UNITED STATES OF AMERICA, and
STATE OF NORTH DAKOTA,

Plaintiffs,

v.

BELLE FOURCHE PIPELINE COMPANY,

Defendant.

FINAL SUPPLEMENTAL CONSENT DECREE

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WHEREAS, Plaintiffs United States of America, on behalf of the United States Environmental Protection Agency ("EPA") and the United States Department of Transportation, Pipeline and Hazardous Materials Safety Administration ("PHMSA"), and the State of North Dakota, on behalf of the Department of Environmental Quality ("NDDEQ") (the "State"), filed a complaint in this action on May 23, 2022, alleging that Belle Fourche Pipeline Company ("Belle Fourche" or "Defendant") is liable for violations of Sections 301(a) and 311(b)(3) of the Clean Water Act ("CWA"), 33 U.S.C. §§ 1311 and 1321(b)(3); of certain safety standards prescribed under Section 60102 of the federal Pipeline Safety Laws, 49 U.S.C. § 60101 *et seq.*, including 49 C.F.R. §§ 195.401 and 195.452; and of N.D.C.C. ch. 61-28. NDDEQ is also alleging that Belle Fourche is liable for NDDEQ's costs under N.D.C.C. ch. 23.1-10.

WHEREAS, the Parties agreed to and the Court entered a Partial Consent Decree on October 1, 2023, resolving Belle Fourche's liability for most of the claims alleged in the Complaint, except for a limited number of discrete claims relating to further remedial activities associated with the Ash Coulee spill. The specific claims that were not resolved by the Partial Consent Decree are identified in the Partial Consent Decree at Paragraphs 63(a) (in the case of the United States) and 64(a-b) (in the case of the State) and are referred to herein as the "Reserved Remediation Claims."

WHEREAS, this Final Supplemental Consent Decree ("Consent Decree" or "Decree") is independent from the Partial Consent Decree and addresses, inter alia, those claims alleged in the Complaint that were not resolved by the Partial Consent Decree (e.g., the Reserved Remediation Claims).

WHEREAS, Belle Fourche does not admit any liability to the United States or the State arising out of the transactions or occurrences alleged in the Complaint.

WHEREAS, the Parties recognize, and the Court by entering this Consent Decree finds, that this Consent Decree has been negotiated by the Parties in good faith and will avoid litigation among the Parties and that this Consent Decree is fair, reasonable, and in the public interest, and furthers the objectives of the federal and state environmental laws.

NOW, THEREFORE, before the taking of any testimony, without the adjudication or admission of any issue of fact or law and with the consent of the Parties, IT IS HEREBY ADJUDGED, ORDERED, AND DECREED as follows:

I. JURISDICTION AND VENUE

1. This Court has jurisdiction over the subject matter of this action pursuant to 33 U.S.C. §§ 1319(b), 1321(b)(7)(E), and 1321(n); 49 U.S.C. § 60120; and 28 U.S.C. §§ 1331, 1345, and 1355. This Court has supplemental jurisdiction over the State law claims asserted by the State of North Dakota pursuant to 28 U.S.C. § 1367.

2. Venue lies in this District pursuant to 33 U.S.C. §§ 1319(b) and 1321(b)(7)(E), 49 U.S.C. § 60120, and 28 U.S.C. §§ 1391 and 1395, because the violations alleged in the Complaint are alleged to have occurred in, and Belle Fourche conducts business in, this judicial district. For purposes of this Decree, or any action to enforce this Decree, Belle Fourche consents to the Court's jurisdiction over this Decree and any such action and over Belle Fourche and consents to venue in this judicial district. For purposes of this Consent Decree only, Belle Fourche agrees that the Complaint states claims upon which relief may be granted.

II. APPLICABILITY

3. The obligations of this Consent Decree apply to and are binding upon the United States and the State, and upon Belle Fourche and any successors, assigns, or other entities or persons otherwise bound by law.

4. Belle Fourche shall provide a copy of this Consent Decree to any President, General Counsel, Environmental Manager, and other managers or field supervisors who will be responsible for implementing the terms of this Consent Decree, and shall ensure that any employees and contractors whose duties might reasonably include compliance with any provision of this Consent Decree are made aware of this Consent Decree and specifically aware of the requirements of this Consent Decree that fall within such person's duties. In any action to enforce this Consent Decree, Belle Fourche may not raise as a defense the failure by any of its officers, directors, employees, agents, or contractors to take any actions necessary to comply with the provisions of this Consent Decree.

III. DEFINITIONS

5. Terms used in this Consent Decree that are defined in the CWA or in regulations promulgated pursuant to the CWA have the meanings assigned to them in the CWA or such regulations, unless otherwise provided in this Decree. Whenever the terms set forth below are used in this Consent Decree, the following definitions apply:

a. "Affiliated Entities" means Bridger Pipeline LLC, Butte Pipe Line Company, and members and owners of Defendant, Bridger Pipeline LLC, and Butte Pipe Line Company.

b. "Agencies" means EPA and NDDEQ.

c. "Ash Coulee Spill" means the discharge or release of crude oil from a rupture on Belle Fourche's Bicentennial Pipeline into an unnamed tributary to Ash Coulee Creek in Billings County, North Dakota, approximately 17.4 pipeline miles west of the Skunk Hill station, reported on December 5, 2016.

d. "Consent Decree" or "Decree" means this Final Supplemental Consent

Decree and all appendices attached hereto.

e. "Day" means a calendar day unless expressly stated to be a business day. In computing any period of time under this Consent Decree, where the last day would fall on a Saturday, Sunday, or federal or State holiday, the period runs until the close of business of the next business day.

f. "Defendant" means Belle Fourche Pipeline Company.

g. "Effective Date" means the date upon which this Consent Decree is entered by the Court or a motion to enter the Consent Decree is granted, whichever occurs first, as recorded on the Court's docket.

h. "EPA" means the United States Environmental Protection Agency and any of its successor departments or agencies.

i. "Interest" means interest at the rate specified in 28 U.S.C. § 1961. The applicable rate of interest is the rate in effect at the time the interest accrues.

j. "Lead Agency" means NDDEQ.

k. "NDDEQ" means the North Dakota Department of Environmental Quality and any of its successor departments or agencies. NDDEQ is the successor agency of the North Dakota Department of Health's Environmental Health Section ("NDDH-EHS"). NDDH-EHS's interest in the causes of action stemming from the Ash Coulee Spill was assigned to NDDEQ under 2017 N.D. Sess. Laws ch. 199, § 1.

l. "Paragraph" means a portion of this Decree identified by an Arabic numeral.

m. "Partial Consent Decree" means the Partial Consent Decree entered by the Court in this action on October 1, 2023 (ECF No. 35).

n. "Parties" means the United States, the State, and Defendant.

o. "Plaintiffs" means the United States and the State of North Dakota.

p. "Remediation Abandonment" occurs if Belle Fourche fails to perform or ceases to comply with the Remediation Work Plan.

q. "Remediation Work Plan" means the work plan attached as Appendix A.

r. "Remediation Standards" means the cleanup standards identified in Paragraph 14.

s. "Reserved Remediation Claims" means the claims identified in the Partial Consent Decree at Paragraphs 63(a) (in the case of the United States) and 64(a-b) (in the case of the State).

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

u. "Site" means the Ash Coulee Creek Remediation Site in Billings County, North Dakota, as generally depicted on the map attached as Appendix B.

v. "State" means the State of North Dakota, acting on behalf of NDDEQ.

w. "United States" means the United States of America, acting on behalf of EPA.

x. "USDOJ" means the United States Department of Justice.

y. "Work Takeover" means NDDEQ's assumption of the performance of any work under this Consent Decree in accordance with Paragraph 12.

IV. PAYMENTS

6. Payments to the United States.

a. For payments to the United States under this Consent Decree pursuant to Section VII (Stipulated Penalties) (if any), Belle Fourche shall pay by FedWire Electronic Funds

Transfer ("EFT") to the United States Department of Justice account, in accordance with the instructions provided by the Financial Litigation Unit ("FLU") of the United States Attorney's Office for the District of North Dakota. The payment instructions provided by the FLU will include a Consolidated Debt Collection System ("CDCS") number, which Belle Fourche must use to identify all payments required to be made in accordance with this Consent Decree. The FLU will provide the payment instructions to:

Kevin Cook, General Counsel
True Companies
PO Drawer 2360
Casper, WY 82602
Tel. (307) 237-9301
Kevin.Cook@Truecos.com

Belle Fourche may change the individual to receive payment instructions on its behalf by providing written notice of such change to the United States.

b. Payments made in accordance with this Paragraph shall reference the civil action number assigned to this case, Civil Action No. 22-00089-DLH-CRH, and DOJ case number 90-5-1-1-11262/2. Any funds received after 11:00 a.m. Eastern Time will be credited on the next business day.

c. At the time of payment, Belle Fourche shall send notice in the form of a copy of the EFT authorization form and the EFT transaction record, together with a transmittal letter, which must state that the payment is for the stipulated penalties owed pursuant to this Consent Decree in *United States and the State of North Dakota v. Belle Fourche Pipeline Co.*, and shall reference the civil action number, CDCS Number, and DOJ case number 90-5-1-1-11262/2 to the United States in accordance with Section XIII (Notices and Submissions).

7. Payments to the State. For payments to the State under this Consent Decree, Belle Fourche shall pay by certified check or cashier's check made payable to the "North Dakota

Department of Environmental Quality" sent to the attention of L. David Glatt, Director, North Dakota Department of Environmental Quality, 4201 Normandy Street, Bismarck, ND 58503-1324. To receive proper credit, the check must reference *United States of America and State of North Dakota v. Belle Fourche Pipeline Company.*

8. Belle Fourche shall not deduct any penalties paid under this Decree pursuant to Section VII (Stipulated Penalties) in calculating its federal or state or local income tax.

V. REMEDIATION MEASURES

9. Belle Fourche shall perform remediation and monitoring of environmental impacts resulting from the Ash Coulee Spill as specified in this Section.

10. Remediation Work Plan. Belle Fourche shall implement the Remediation Work Plan, attached as Appendix A, in accordance with the schedule set forth herein.

a. Belle Fourche has completed Element 2 (Investigation Phase) of the Remediation Work Plan, and shall have no obligations under this Consent Decree for Element 2.

b. By no later than November 30, 2026, Belle Fourche shall complete Elements 3 (Excavation), 4 (Run-off Controls), 5 (Installation of Fluid Management System), 6 (500-year Riprap Flood Protection), and 7 (Cathodic Wall Protection) of the Remediation Work Plan.

c. Elements 2, 3, 4, 5, 6, and 7 of the Remediation Work Plan are one-time requirements. Following completion of all of these elements, Belle Fourche may seek partial termination of the requirement to perform these elements pursuant to Paragraph 80.

d. Belle Fourche shall continue to implement Elements 1 (Existing Remediation) and 8 (Monitoring) of the Remediation Work Plan until this Consent Decree is fully terminated pursuant to Paragraph 81.

11. Monitoring Work Plan. All monitoring, sampling and analysis required by Element 8 of the Remediation Work Plan shall be done in accordance with the Monitoring Work Plan attached as Appendix D.

12. Work Takeover.

a. If NDDEQ, in consultation with EPA, determines that Belle Fourche (i) has ceased to implement any element of the Remediation Work Plan as required by this Section; (ii) is seriously or repeatedly deficient or late in implementing any element of the Remediation Work Plan; or (iii) is implementing any element of the Remediation Work Plan in a manner that may cause an endangerment to human health or the environment, NDDEQ may issue a notice of a full or partial Work Takeover to Belle Fourche, including a description of the grounds for the notice and a period of time ("Remedy Period") within which Belle Fourche must remedy the circumstances giving rise to the notice. The Remedy Period will be 30 days, unless NDDEQ determines in its unreviewable discretion that there may be an endangerment, in which case the Remedy Period will be 15 days.

b. If, by the end of the Remedy Period, Belle Fourche has not remedied the circumstances giving rise to the notice of Work Takeover to NDDEQ's satisfaction, NDDEQ, in consultation with EPA, may notify Belle Fourche and, as it deems necessary, commence a full or partial Work Takeover.

c. NDDEQ may conduct the Work Takeover during the pendency of any dispute under Section IX (Dispute Resolution) but shall terminate the Work Takeover if and when: (i) Belle Fourche remedies, to NDDEQ's satisfaction, in consultation with EPA, the circumstances giving rise to the notice of Work Takeover; or (ii) upon the issuance of a final

determination under Section IX (Dispute Resolution) that NDDEQ is required to terminate the Work Takeover.

13. Environmental Covenant. Belle Fourche has obtained the environmental covenant attached hereto as Appendix C (the "Environmental Covenant") ensuring both that use of the Site will remain compatible with conditions at the Site following implementation of the Remediation Work Plan, and access to the Site for the purpose of implementing the Remediation Work Plan. Belle Fourche shall file the Environmental Covenant with the Billings County recorder within 30 days after the Effective Date. Belle Fourche shall provide a copy of the Environmental Covenant in its recorded form to: (a) each person that signed the covenant or their successor or assign, (b) each person in possession of the Site (or a portion of the Site), (c) each municipality or unit of local government in which the Site is located, and (d) NDDEQ.

14. Remediation Standards. Belle Fourche shall meet the following Remediation Standards:

a. The clean-up standard for those areas that are to be excavated in accordance with Section 6.3 of the Remediation Work Plan is 500 ppm TPH (total petroleum hydrocarbons).

b. The clean-up standard for all other areas at the Site is 1200 ppm TPH.

c. Once the Remediation Standards for the "Lowland Area" and "Upland Area" (as those areas are described in the Remediation Work Plan) have been achieved (or they have been terminated pursuant to Paragraph 81), the Site shall be revegetated with appropriate native vegetation.

15. Site Access. Belle Fourche has obtained an agreement giving it and the Agencies access to the Site for the purpose of implementing the Remediation Work Plan. If, during

implementation of the Remediation Work Plan, Belle Fourche is denied access to the Site, Belle Fourche shall take immediate action to enforce its access agreement and notify Plaintiffs. Belle Fourche's notice to Plaintiffs shall include a description of the steps it has taken and/or plans to take to regain access. If Plaintiffs deem it appropriate, they may assist Belle Fourche, or take independent action, to obtain access to the Site. If Plaintiffs choose (in their sole discretion) to assist Belle Fourche or take action to obtain access, Belle Fourche will cooperate with Plaintiffs to obtain access. The Force Majeure provisions of the Consent Decree shall govern whether any deadlines to perform the obligations of the Consent Decree (including the Remediation Work Plan) shall be extended in the event of a denial of access. For purposes of this Paragraph only, the term "best efforts" in the Force Majeure provision means the efforts that a reasonable person in Belle Fourche's position would use so as to achieve the goal in a timely manner, including the cost of employing professional assistance, the payment of reasonable sums of money to secure access, and bringing a legal action in an appropriate court to secure access.

16. Financial Assurance. To ensure completion of Elements 3 (Excavation), 4 (Run-off Controls), 5 (Installation of Fluid Management System), 6 (500-year Riprap Flood Protection), and 7 (Cathodic Wall Protection) of the Remediation Work Plan, Belle Fourche shall provide financial assurance, in the initial amount of $2,000,000 ("Estimated Cost of the Work"), for the benefit of NDDEQ. As of the date of lodging, Belle Fourche has met this requirement by providing (1) a letter of written guarantee from Bridger Pipeline LLC (Bridger) that Bridger shall pay to ensure completion of the Remediation Work Plan if Belle Fourche fails to do so, and (2) documentation sufficient to show that Bridger meets the corporate guarantee requirements outlined in Paragraph 19 below.

17. Belle Fourche shall diligently monitor the adequacy of its financial assurance. If

Belle Fourche 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, Belle Fourche shall notify NDDEQ of such information within seven days. If NDDEQ determines that the financial assurance provided under this Section is inadequate or otherwise no longer satisfies the requirements of this Section, NDDEQ will notify Belle Fourche of such determination. Belle Fourche shall, within 30 days after notifying NDDEQ or receiving notice from NDDEQ under this Paragraph, secure and submit to NDDEQ for approval a proposal for a revised or alternative corporate guarantee, or other financial assurance mechanism that meets the requirements of Paragraph 18. NDDEQ's approval shall not be unreasonably withheld. NDDEQ may extend this deadline for such time as is reasonably necessary for Belle Fourche, in the exercise of due diligence, to secure and submit to NDDEQ a proposal for a revised or alternative financial assurance mechanism, not to exceed 60 days.

18. The following are acceptable financial assurance mechanisms:

a. a surety bond guaranteeing payment, performance, or both, of the Remediation Work and Monitoring Work 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 NDDEQ or at the direction of NDDEQ, 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;

c. a trust fund established for the benefit of NDDEQ 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;

d. a policy of insurance that provides NDDEQ with acceptable rights as a beneficiary thereof and that is issued by an insurance carrier that has the authority to issue insurance policies in the applicable jurisdiction(s) and whose insurance operations are regulated and examined by a federal or state agency;

e. a demonstration by Belle Fourche that it meets the relevant financial test criteria of Paragraph 19, accompanied by a standby funding commitment that requires Belle Fourche to pay funds to or at the direction of NDDEQ, up to the amount financially assured through the use of this demonstration in the event of a Work Takeover; or

f. a corporate guarantee to fund or perform the Remediation Work Plan executed in favor of NDDEQ by a company: (1) that is a direct or indirect parent company of Belle Fourche or has a "substantial business relationship" (as defined in 40 C.F.R. § 264.141(h)) with Belle Fourche; and (2) demonstrates to NDDEQ's satisfaction that it meets the financial test criteria of Paragraph 19.

19. For a corporate guarantee, the corporate guarantor must meet the requirements in subparagraph a and submit the information required by subparagraph b:

a. The corporate guarantor has:

(1) a ratio of current assets to current liabilities greater than 1.5; or a current rating for its senior unsecured debt of AAA, AA, A, or BBB as issued by Standard and Poor's or Aaa, Aa, A or Baa as issued by Moody's;

(2) net working capital and tangible net worth each at least four times the sum of the Estimated Cost of the Work and the amounts, if any,

of other federal, state, or tribal environmental obligations financially assured through the use of a financial test or guarantee;

(3) tangible net worth of at least $2 million; and

(4) assets located in the United States amounting to at least four times the sum of the Estimated Cost of the Work and the amounts, if any, of other federal, state, or tribal environmental obligations financially assured through the use of a financial test or guarantee.

b. The corporate guarantor shall submit to NDDEQ:

(1) a letter from its chief financial officer (CFO), certifying that the corporate guarantor satisfies the conditions in Paragraph 19 and that it guarantees completion of the Remediation Work Plan;

(2) a copy of an independent certified public accountant's report on examination of the entity's financial statements for the latest completed fiscal year, which must not express an adverse opinion or disclaimer of opinion; and

(3) a report from an independent certified public accountant stating that the accountant has reviewed the letter from the CFO and confirmed that nothing causes the accountant to believe that the CFO's letter should be adjusted.

20. So long as Belle Fourche elects to meet its financial assurance obligations under this Decree using a corporate guarantee, but only up to and not after the date the Parties file a joint stipulation terminating the requirements to perform Elements 3 through 7 in the Remediation Work Plan, it must also:

a. within 150 days after the close of the corporate guarantor's fiscal year, submit a copy of an independent certified public accountant's report on examination of the corporate guarantor's financial statements for the latest completed fiscal year;

b. provide NDDEQ, within 30 days of NDDEQ's request, reports of the financial condition of the corporate guarantor in addition to those specified in Paragraph 19. NDDEQ may make such a request at any time based on a reasonable belief that the corporate guarantor may no longer meet the financial test requirements of Paragraph 19.

21. Access to Financial Assurance After Notice of a Work Takeover.

a. If NDDEQ issues a notice of a Work Takeover under Paragraph 12.b, NDDEQ may require that any funds guaranteed be paid in accordance with any applicable financial assurance mechanism.

b. If NDDEQ is notified that the issuer of a financial assurance mechanism intends to cancel the mechanism, and Belle Fourche fails to provide an alternative financial assurance mechanism in accordance with Paragraph 17 at least 30 days prior to the cancellation date, the funds guaranteed under such mechanism must be paid prior to cancellation in accordance with subparagraph d.

c. If, upon issuance of a notice of a Work Takeover under Paragraph 12.b, either: (1) NDDEQ is unable for any reason to promptly secure the resources guaranteed under any applicable financial assurance mechanism including the related standby funding commitment, whether in cash or in kind, to continue and complete the Remediation and Monitoring Work; or (2) the financial assurance is a demonstration or guarantee under Paragraph 16 or 17, then NDDEQ is entitled to demand an amount, as it determines, sufficient to cover the cost to complete any remaining work required by the Remediation Work Plan. Belle

Fourche shall, within 30 days after such demand, pay the amount demanded as directed by NDDEQ.

d. Any amounts required to be paid under this Paragraph must, as directed by NDDEQ, be: (i) paid to NDDEQ in order to facilitate the completion of the Remediation Work Plan by NDDEQ 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 Remediation Work Plan by another person.

22. Modification of Amount, Form, or Terms of Financial Assurance. Beginning after the first anniversary of the Effective Date, and no more than once per calendar year, if the Parties have not filed a joint stipulation terminating the requirements to perform Elements 3 through 7 in the Remediation Work Plan, Belle Fourche may submit a request to change the form, terms, or amount of the financial assurance mechanism. Any such request must be submitted to NDDEQ for approval, which shall not be unreasonably withheld, and must include an estimate of the cost of the remaining work required by the Remediation Work Plan, 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. NDDEQ will notify Belle Fourche of its decision regarding the request. Belle Fourche may initiate dispute resolution under Section IX regarding NDDEQ's decision within 30 days after receipt of the decision. Belle Fourche may modify the form, terms, or amount of the financial assurance mechanism only: (a) in accordance with NDDEQ's approval; or (b) in accordance with any resolution of a dispute under Section IX. Belle Fourche shall submit to NDDEQ, within 30 days after receipt of NDDEQ's approval or disapproval 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.

23. Release, Cancellation, or Discontinuation of Financial Assurance. Belle Fourche may release, cancel, or discontinue any financial assurance provided under Paragraph 16 only: (a) upon the filing a joint stipulation terminating the requirements to perform Elements 3 through 7 in the Remediation Work Plan; or (b) if there is a dispute regarding the release, cancellation or discontinuance of any financial assurance, in accordance with the agreement, final administrative decision, or final judicial decision resolving such dispute under Section IX.

24. Reimbursement of State Response Costs. The State shall send Belle Fourche an annual invoice on or before March 1st of each year setting forth in reasonable detail the response costs related to the implementation of the Remediation Work Plan (including, without limitation, costs of reviewing and supervising any of Belle Fourche's submissions under this Consent Decree), provided the total amount included on an annual invoice shall not exceed $10,000. Notwithstanding the foregoing, if there is a Remediation Abandonment, the State's annual invoice may exceed $10,000. Belle Fourche shall pay the State for the invoiced response costs within 30 days in accordance with Paragraph 7.

VI. REPORTING REQUIREMENTS

25. In addition to the reports or submittals expressly required by Section V (Remediation Measures), Belle Fourche must submit an annual report by March 31 of each year to the Agencies that includes the following information as it pertains to the preceding calendar year:

a. A summary of activities at the Site for the last annual period, expected activities for the next annual period, and a summary of all groundwater, surface water, and soils data;

b. Any known violation of any requirement of this Consent Decree, the

duration of the violation, the remedial steps taken, or to be taken, to prevent or minimize such violation, and a full explanation of the cause of the violation; and

c. The status of implementation of any other Consent Decree requirements under Section V (Remediation Measures), and problems encountered or anticipated, together with implemented or proposed solutions.

26. In any annual report submitted pursuant to this Section, Belle Fourche may request NDDEQ approval to reduce the frequency or eliminate sampling or recovery. NDDEQ shall review the request, consult with EPA, and determine, in NDDEQ's sole discretion, if reduction or elimination of sampling or recovery is appropriate. NDDEQ's decision shall not be subject to dispute resolution.

27. Belle Fourche shall provide any other materials and information relevant to demonstrating its compliance with the requirements of Section V (Remediation Measures) within 15 days after the request by one or more Agencies, subject to the attorney client, work product or other applicable privileges. In the event Belle Fourche withholds any material or information requested pursuant to this Paragraph on the basis of privilege, Belle Fourche shall assert the claim in writing with the detail described in paragraph 57 of this Consent Decree.

28. All written reports or submissions required of Belle Fourche under this Consent Decree must be signed by a Belle Fourche official and include the following certification:

> I certify under penalty of law 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.

29. The reporting requirements of this Consent Decree do not relieve Belle Fourche of any reporting obligations required by the CWA or implementing regulations, the North Dakota Century Code or implementing regulations, or any other federal, state, or local law, regulation, permit, or other requirement.

30. Belle Fourche shall report any unpermitted discharge from the Site that causes a sheen on surface water in accordance with federal and state law or within 24 hours, whichever is earlier. Belle Fourche shall submit such report to the Agencies and any other legally required recipient(s) under federal and state law.

31. Any information provided pursuant to this Consent Decree may be used by the United States and the State in any proceeding to enforce the provisions of this Consent Decree and as otherwise permitted by law.

VII. STIPULATED PENALTIES

32. Belle Fourche shall be liable for stipulated penalties to the United States and the State for violations of this Consent Decree as specified below, unless excused under Section VIII (Force Majeure). A violation includes failing to perform any obligation required by the terms of this Decree, including any work plan or schedule approved under this Decree, according to all applicable requirements of this Decree and within the specified time schedules established by or approved under this Decree.

a. Remediation Measures.

Consent Decree Violation	Stipulated Penalty
Failure to implement Remediation Work Plan, as required by Paragraph 10	$1,250 per day for the first 30 days of noncompliance; $2,500 per day thereafter.
Failure to record the Environmental Covenant as required by Paragraph 13	$1,000 per day for the first 30 days of noncompliance; and $2,000 per day

	thereafter.
Failure to secure and maintain the Financial Assurance as required by Paragraphs 16-20	$1,000 per day for the first 30 days of noncompliance; $2,000 per day thereafter.
Failure to make a payment as required by Paragraph 24	$2,500 per day for each day the payment is late.

b. Periodic Reports.

Consent Decree Violation	Stipulated Penalty
Failure to submit an annual report as required by Paragraph 22	$500 per day for the first 30 days of noncompliance; and $1,000 per day thereafter.

33. Work Takeover Penalty. If NDDEQ commences a Work Takeover, Belle Fourche shall be liable for a stipulated penalty in the amount of $100,000. This stipulated penalty is in addition to the remedy available to NDDEQ under Paragraph 18 (Access to Financial Assurance After Notice of a Work Takeover) to fund the performance of the Remediation Work and Monitoring Work by NDDEQ.

34. Stipulated penalties under this Section shall begin to accrue on the day after performance is due or on the day a violation occurs, whichever is applicable, and shall continue to accrue until performance is satisfactorily completed or until the violation ceases. Stipulated penalties shall accrue simultaneously for separate violations of this Consent Decree.

35. Belle Fourche shall pay stipulated penalties to the United States and the State within 30 days of a written demand by either Plaintiff. Belle Fourche shall pay 50% of the total stipulated penalty amount due to the State and 50% of the total stipulated penalty amount due to the United States. The Plaintiff making a demand for payment of a stipulated penalty shall simultaneously send a copy of the demand to the other Plaintiff.

36. Either Plaintiff may, in the unreviewable exercise of its discretion, reduce or

waive stipulated penalties otherwise due it under this Consent Decree.

37. Stipulated penalties shall continue to accrue as provided in Paragraph 29 during any Dispute Resolution, but need not be paid until:

a. If the dispute is resolved by agreement of the Parties or by a decision of the United States and the State that is not appealed to the Court, Belle Fourche shall pay accrued penalties determined to be owing, together with Interest, to the United States and the State within 30 days of the effective date of the agreement or the receipt of the United States' and the State's decision or order.

b. If the dispute is appealed to the Court and the United States or the State prevails in whole or in part, Belle Fourche shall pay all accrued penalties determined by the Court to be owing, together with Interest, within 60 days of receiving the Court's decision or order, except as provided in subparagraph c, below.

c. If any Party appeals the District Court's decision, Belle Fourche shall pay all accrued penalties determined to be owing, together with Interest, within 15 days of receiving the final appellate court decision.

38. Belle Fourche shall pay stipulated penalties owing to the United States in the manner set forth in Paragraph 6.a. At the time of payment, Belle Fourche shall send notice that payment has been made to the United States Department of Justice, in accordance with Section XIII (Notices and Submissions). Such notice must state that the payment is for stipulated penalties owed pursuant to the Consent Decree in *United States and the State of North Dakota v. Belle Fourche Pipeline Company*, must state for which violation(s) the penalties are being paid, and must reference the Civil Action Number 22-00089-DLH-CRH, CDCS Number, and DOJ case number 90-5-1-1-11262/2.

39. Belle Fourche shall pay stipulated penalties owing to the State in the manner required by Paragraph 7, except that the check must be accompanied by a transmittal letter stating that the payment is for stipulated penalties and must state for which violation(s) the penalties are being paid.

40. If Belle Fourche fails to pay stipulated penalties according to the terms of this Consent Decree, Belle Fourche shall pay Interest on such penalties accruing as of the date payment became due. Nothing in this Paragraph shall be construed to limit the United States or the State from seeking any remedy otherwise provided by law for Belle Fourche's failure to pay any stipulated penalties.

41. The payment of penalties and interest, if any, will not alter in any way Belle Fourche's obligation to complete the performance of the requirements of this Consent Decree.

42. Non-Exclusivity of Remedy. Stipulated penalties are not Plaintiffs' exclusive remedy for violations of this Consent Decree. Subject to the provisions of Section XI (Effect of Settlement/Reservation of Rights), each Plaintiff expressly reserves the right to seek any other relief it deems appropriate for Belle Fourche's violation of this Decree.

VIII. FORCE MAJEURE

43. "Force Majeure," for purposes of this Consent Decree, is defined as any event arising from causes beyond the control of Belle Fourche, of any entity controlled by Belle Fourche, or of Belle Fourche's contractors, that delays or prevents the performance of any obligation under this Consent Decree despite Belle Fourche's best efforts to fulfill the obligation. The requirement that Belle Fourche exercise "best efforts to fulfill the obligation" includes using best efforts to anticipate any potential force majeure event and best efforts to address the effects of any potential force majeure event (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. "Force Majeure" does not include Belle Fourche's financial inability to perform any obligation under this Consent Decree or unanticipated or increased costs or expenses associated with the performance of Belle Fourche's obligations under this Consent Decree.

44. If any event occurs or has occurred that may delay the performance of any obligation under this Consent Decree, whether or not caused by a Force Majeure event, Belle Fourche shall provide notice orally or by email to the Lead Agency, as soon as practicable, but in no event later than 72 hours of when Belle Fourche first knew that the event might cause a delay. Within 10 days thereafter, Belle Fourche shall provide in writing to the Lead Agency an explanation and description of the reasons for the delay; the anticipated duration of the delay; all actions taken or to be taken to prevent or minimize the delay; a schedule for implementation of any measures to be taken to prevent or mitigate the delay or the effect of the delay; Belle Fourche's rationale for attributing such delay to a force majeure event if they intend to assert such a claim; and a statement as to whether, in the opinion of Belle Fourche, such event may cause or contribute to an endangerment to public health, welfare or the environment. Belle Fourche shall include with any notice all available documentation supporting the claim that the delay was attributable to a force majeure. Failure to comply with the above requirements shall preclude Belle Fourche from asserting any claim of force majeure for that event for the period of time of such failure to comply, and for any additional delay caused by such failure. Belle Fourche shall be deemed to know of any circumstance of which either Belle Fourche, any entity controlled by Belle Fourche, or Belle Fourche's contractors knew or should have known.

45. If NDDEQ, after consultation with EPA, agrees that the delay or anticipated delay is attributable to a force majeure event, the time for performance of the obligations under this

Consent Decree that are affected by the Force Majeure event will be extended by NDDEQ for such time as is necessary to complete those obligations. An extension of the time for performance of the obligations affected by the Force Majeure event will not, of itself, extend the time for performance of any other obligation. NDDEQ will notify Belle Fourche in writing of the length of the extension, if any, for performance of the obligations affected by the Force Majeure event.

46. If NDDEQ, after consultation with EPA, does not agree that the delay or anticipated delay has been or will be caused by a Force Majeure event, NDDEQ will notify Belle Fourche in writing of its decision.

47. If Belle Fourche elects to invoke the dispute resolution procedures set forth in Section IX (Dispute Resolution), it must do so no later than 30 days after receipt of notice pursuant to Paragraph 46. In any such proceeding, Belle Fourche will have the burden of demonstrating by a preponderance of the evidence that the delay or anticipated delay has been or will be caused by a Force Majeure event, that the duration of the delay or the extension sought was or will be warranted under the circumstances, that best efforts were exercised to avoid and mitigate the effects of the delay, and that Belle Fourche complied with the requirements of Paragraphs 43 and 44. If Belle Fourche carries this burden, the delay at issue will be deemed not to be a violation by Belle Fourche of the affected obligation of this Consent Decree.

IX. DISPUTE RESOLUTION

48. Unless otherwise expressly provided for in this Consent Decree, the dispute resolution procedures of this Section shall be the exclusive mechanism to resolve disputes arising under or with respect to this Consent Decree. Belle Fourche's failure to seek resolution of a dispute under this Section shall preclude Belle Fourche from raising any such issue as a defense

to an action by the United States or the State to enforce any obligation of Belle Fourche arising under this Decree.

49. Informal Dispute Resolution. Any dispute subject to Dispute Resolution under this Consent Decree shall first be the subject of informal negotiations. The dispute shall be considered to have arisen when Belle Fourche sends the United States and the State a written Notice of Dispute. Such Notice of Dispute shall state clearly the matter in dispute and Belle Fourche's position. The period of informal negotiations shall not exceed 45 days from the date the dispute arises, unless that period is modified by written agreement by all Parties. If the Parties cannot resolve a dispute by informal negotiations, then the position advanced by the United States and the State will be considered binding unless, within 45 days after the conclusion of the informal negotiation period, Belle Fourche invokes formal dispute resolution procedures as set forth below.

50. Formal Dispute Resolution. Belle Fourche shall invoke formal dispute resolution procedures, within the time period provided in the preceding Paragraph, by serving on the United States and the State a written Statement of Position regarding the matter in dispute. The Statement of Position must include, but need not be limited to, any factual data, analysis, or opinion supporting Belle Fourche's position and any supporting documentation relied upon by Belle Fourche.

51. The United States and the State shall serve their Statement of Position within 60 days of receipt of Belle Fourche's Statement of Position. The United States and the State's Statement of Position must include, but need not be limited to, any factual data, analysis, or opinion supporting that position and any supporting documentation relied upon by the United States and the State. The United States and the State's Statement of Position will be binding on

Belle Fourche, unless Belle Fourche files a motion for judicial review of the dispute in accordance with the following Paragraph.

52. Belle Fourche may seek judicial review of the dispute by filing with the Court and serving on the United States and the State, in accordance with Section XIII (Notices and Submissions), a motion requesting judicial resolution of the dispute. The motion must be filed within 30 days of receipt of the United States and the State's Statement of Position pursuant to the preceding Paragraph. The motion must contain a written statement of Belle Fourche's position on the matter in dispute, including any supporting factual data, analysis, opinion, or documentation, and must set forth the relief requested and any schedule within which the dispute must be resolved for orderly implementation of the Consent Decree.

53. The United States and the State shall respond to Belle Fourche's motion within the time period allowed by the Local Rules of this Court. Belle Fourche may file a reply memorandum, to the extent permitted by the Local Rules.

54. Standard of Review. Belle Fourche shall bear the burden of demonstrating that its position complies with this Consent Decree and better furthers the objectives of the Decree. The objectives of this Consent Decree are to protect public health and welfare and the environment through the implementation of the elements of the Remediation Work Plan at the Site by Belle Fourche and to resolve the Reserved Remediation Claims and the additional claims identified in Section XI, as provided in this Consent Decree.

55. The invocation of dispute resolution procedures under this Section shall not, by itself, extend, postpone, or affect in any way any obligation of Belle Fourche under this Consent Decree, unless and until final resolution of the dispute so provides. Stipulated penalties with respect to the disputed matter shall continue to accrue from the first day of noncompliance, but

payment shall be stayed pending resolution of the dispute as provided in Paragraph 37. If Belle Fourche does not prevail on the disputed issue, stipulated penalties shall be assessed and paid as provided in Section VII (Stipulated Penalties).

X. INFORMATION COLLECTION AND RETENTION; ACCESS TO PROPERTIES

56. Belle Fourche has an agreement with the owner of the Site, which also gives the United States, the State, and their representatives, the right of entry at all reasonable times to the Site. Belle Fourche will not object to right of entry, in accordance with any grant of such entry by the property owner, to the United States, State, and their representatives, including attorneys, contractors, and consultants, in order to:

a. monitor the progress of activities required under this Consent Decree;

b. verify any data or information submitted to the United States or the State in accordance with the terms of this Consent Decree;

c. obtain samples and, upon request, splits of any samples taken by Belle Fourche or its representatives, contractors, or consultants;

d. obtain documentary evidence, including photographs and similar data; and

e. assess Belle Fourche's compliance with this Consent Decree.

57. Belle Fourche may assert that certain documents, records, or other information subject to Paragraph 56 are privileged under the attorney-client privilege or any other privilege recognized by federal law. If Belle Fourche asserts such a privilege, they shall provide the following: (a) the title of the document, record, or information; (b) the date of the document, record, or information; (c) the name and title of each author of the document, record, or information; (d) the name and title of each addressee and recipient; (e) a description of the subject of the document, record, or information; and (f) the privilege asserted by Belle Fourche.

However, no documents, records, or other information created or generated pursuant to the requirements of this Consent Decree (including, without limitation, such documents, records, or other information Belle Fourche retains under Paragraph 59 below to demonstrate compliance) shall be withheld on grounds of privilege.

58. Upon request, Belle Fourche shall provide EPA and the NDDEQ or their authorized representatives splits of any samples taken by Belle Fourche or its representative, contractors, or consultants regarding the Ash Coulee Spill. Upon request, EPA and the State shall provide Belle Fourche splits of any samples taken by EPA or the State regarding the Ash Coulee Spill.

59. Belle Fourche shall retain and shall instruct its contractors and agents to preserve documents, records, or other information (including documents, records, or other information in electronic form) sufficient to demonstrate compliance with its obligations under this Consent Decree, until three years after the termination of this Consent Decree. This information-retention requirement will apply regardless of any contrary corporate or institutional policies or procedures. At any time during this information-retention period, upon request by the United States or the State, Belle Fourche must provide copies of any documents, records, or other information required to be maintained under this Paragraph.

60. At the conclusion of the information-retention period provided in Paragraph 59, Belle Fourche must notify the United States and the State at least 90 days prior to the destruction of any documents, records, or other information subject to the requirements of the preceding Paragraph and, upon request by the United States or the State, Belle Fourche must deliver any such documents, records, or other information to the United States or the State.

61. Belle Fourche may also assert that information required to be provided under this

Section is protected as Confidential Business Information ("CBI") under 40 C.F.R. Part 2, 49 C.F.R. Part 7, and 49 C.F.R. Part 190. As to any information that Belle Fourche seeks to protect as CBI, Belle Fourche must follow the procedures set forth in 40 C.F.R. Part 2, 49 C.F.R. Part 7, and 49 C.F.R. Part 190.

62. This Consent Decree in no way limits or affects any right of entry and inspection, or any right to obtain information, held by the United States or the State pursuant to applicable federal or state laws, regulations, or permits, nor does it limit or affect any duty or obligation of Belle Fourche to maintain documents, records, or other information imposed by applicable federal or state laws, regulations, or permits.

XI. EFFECT OF SETTLEMENT/RESERVATION OF RIGHTS

63. The Partial Consent Decree, with limited exceptions, "resolve[d] the civil claims of the United States and the State against Belle Fourche for the violations alleged in the North Dakota Complaint." The Partial Consent Decree also contains the following covenants not to sue, (1) "Except as provided in Paragraph 63 [of the Partial Consent Decree], the United States covenants not to sue or assert against Defendants or their Affiliated Entities any civil or administrative claims that could have been brought under the CWA, the Pipeline Safety Laws, or Section 7003 of the Resource Conservation and Recovery Act ("RCRA Section 7003"), 42 U.S.C. § 6973, arising from the Ash Coulee Spill;" and (2) "Except as provided in Paragraph 64 [of the Partial Consent Decree,] the State covenants not to sue or assert against Defendants or their Affiliated Entities any civil or administrative claims brought or that could have been brought under federal law, or North Dakota law arising from the Ash Coulee Spill." This Consent Decree does not affect these resolutions of claims, and the covenants not to sue, in the Partial Consent Decree, and they remain in full force and effect. Any reservations of rights in

Paragraphs 63 and 64 of the Partial Consent Decree that are not specifically reserved in Paragraph 65 of this Consent Decree are void and no longer in effect.

64. Except as provided in Paragraph 65 below, this Consent Decree resolves (a) the Reserved Remediation Claims, (b) the State's claims relating to the abandonment of solid waste relating to the Ash Coulee Spill, and (c) Plaintiffs' claims, through the date of lodging, for any discharges or releases to surface water relating to the Ash Coulee Spill.

65. The United States and the State reserve, and this Decree is without prejudice to, all rights against Belle Fourche with respect to all matters not expressly included within Paragraphs 63 and 64 of this Decree, including, but not limited to:

a. all legal and equitable remedies available to enforce the provisions of this Consent Decree;

b. all legal and equitable remedies available to address any imminent and substantial endangerment to the public health or welfare or the environment arising at the Site, provided the imminent and substantial endangerment also arises from (1) new or changed conditions at or near the location of the Ash Coulee Spill after the date of lodging of this Decree or (2) existing conditions at or near the location of the Ash Coulee Spill that were not known by the Plaintiffs as of the date of lodging of this Decree. For purposes of this Paragraph, information and conditions known to the Plaintiffs as of the lodging of this Decree includes only the information and conditions set forth in the United States and the State's files for the Ash Coulee Spill as of the date of the lodging of this Decree. Furthermore, for purposes of this Paragraph, the mere presence or migration of hydrocarbons within the subsurface three-dimensional area known to contain hydrocarbons as of the date of lodging, without more, shall not constitute new or changed conditions; and

c. claims for discharges or releases to surface water relating to the Ash Coulee Spill after the date of lodging of this Decree, except, in the case of the State only, such claims under N.D.D.C. ch. 61-28.

66. The Work Plan is not subject to any reopener during the period that the Court has jurisdiction over this action. If there are future discharges to surface water after the Date of Lodging or the Site poses an imminent and substantial endangerment after the Date of Lodging, they will only be addressed by new actions, and the United States and State reserve those claims, as expressly provided in Paragraphs 65.b and c.

67. In any subsequent administrative or judicial proceeding initiated by the United States or the State for injunctive relief, civil penalties, or other appropriate relief relating to the Site, Belle Fourche shall not assert, and may not maintain, any defense or claim based upon the principles of waiver, res judicata, collateral estoppel, issue preclusion, claim preclusion, claim-splitting, or other defenses based upon any contention that the claims raised by the United States or the State in the subsequent proceeding were or should have been brought in the instant case, except with respect to claims that have been specifically resolved, or for which there is a covenant not to sue, pursuant to the Partial Consent Decree.

68. This Consent Decree is not a permit, or a modification of any permit, under federal, state, or local laws or regulations. Belle Fourche is responsible for achieving and maintaining complete compliance with all applicable federal, state, and local laws, regulations, and permits; and Belle Fourche's compliance with this Consent Decree shall be no defense to any action commenced pursuant to any such laws, regulations, or permits, except as set forth herein. The United States and the State do not, by their consent to the entry of this Consent Decree, warrant or aver in any manner that Belle Fourche's compliance with any aspect of this

Consent Decree will result in compliance with provisions of the CWA, the North Dakota Century Code, or with any other provisions of federal, state, or local laws, regulations, or permits.

69. This Consent Decree does not limit or affect the rights of Belle Fourche and its Affiliated Entities or of the United States or the State against any third parties not party to this Consent Decree, nor does it limit the rights of third parties, not party to this Consent Decree, against Belle Fourche, except as otherwise provided by law.

70. This Consent Decree shall not be construed to create rights in, or grant any cause of action to, any third party not party to this Consent Decree.

XII. COSTS

71. The Parties shall bear their own costs of this action, including attorneys' fees, except that the United States and the State shall be entitled to collect the costs (including attorneys' fees) incurred in any action necessary to collect any portion of the response costs (as to the State only) or any stipulated penalties due but not paid by Belle Fourche.

XIII. NOTICES AND SUBMISSIONS

72. Unless otherwise specified in this Decree, whenever notifications, submissions, or communications are required by this Consent Decree, they must be made in writing and addressed as follows:

a. EPA

By email: Hohman.Darla@usepa.gov

By mail: Darla Hohman
Mail Code: 8ENF-RO
U.S. Environmental Protection Agency, Region 8
1595 Wynkoop Street

Denver, CO 80202

b. USDOJ

By email: eescdcopy.enrd@usdoj.gov
Re: DJ # 90-5-1-1-11262/2

By mail: EES Case Management Unit
Environment and Natural Resources Division
U.S. Department of Justice
P.O. Box 7611
Washington, DC 20044-7611
Re: DJ # 90-5-1-1-11262/2

c. NDDEQ

By email: bsuess@nd.gov

By mail: Bill Suess
North Dakota Department of Environmental Quality
4201 Normandy Street
Bismarck, ND 58503-1324

d. North Dakota Attorney General.

By email: amerkens@nd.gov

By mail: Matthew A. Sagsveen
North Dakota Office of Attorney General
500 N. 9th Street
Bismarck, ND 58501

e. United States. Notice to the United States shall be provided to EPA and DOJ.

f. State. Notice to the State shall be provided to NDDEQ and the North Dakota Attorney General.

g. Belle Fourche

By email: Kevin.Cook@Truecos.com

By mail: Kevin Cook, General Counsel
True Companies

PO Drawer 2360
Casper, WY 82602

73. Any Party may, by written notice to the other Parties, change its designated notice recipient or notice address provided above.

74. Notices submitted pursuant to this Section shall be deemed submitted upon mailing or transmission by email, unless otherwise provided in this Consent Decree or by mutual agreement of the Parties in writing.

75. Submissions to Plaintiffs under this Consent Decree must be made electronically and, upon request, Belle Fourche must provide hard copies or originals of any materials provided electronically.

76. Any supporting documents used in the preparation of submissions to Plaintiffs must be maintained electronically and made available upon request.

XIV. RETENTION OF JURISDICTION

77. The Court shall retain jurisdiction over this case and the Parties until termination of this Consent Decree, for the purpose of resolving disputes arising under this Decree or entering orders modifying this Decree, pursuant to Section IX (Dispute Resolution) or Section XV (Modification), or effectuating or enforcing compliance with the terms of this Decree.

XV. MODIFICATION

78. The terms of this Consent Decree, including any attached appendices, may be modified only by a subsequent written agreement signed by all the Parties, except that (a) extensions of deadlines for compliance measures and deliverables and (b) reductions in the frequency of any monitoring, sampling and analysis will be effective upon written approval by NDDEQ, after consultation with EPA. Where the modification constitutes a material change to this Decree, it will be effective only upon approval by the Court.

79. Any disputes concerning modification of this Decree shall be resolved pursuant to Section IX (Dispute Resolution). The Party seeking the modification bears the burden of demonstrating that it is entitled to the requested modification in accordance with Federal Rule of Civil Procedure 60(b).

XVI. TERMINATION

80. Partial Termination as to Elements 3 through 7 in the Remediation Work Plan. Upon completion of Elements 3 (Excavation), 4 (Run-off Controls), 5 (Installation of Fluid Management System), 6 (500-year Riprap protection), and 7 (Cathodic Wall Protection), Belle Fourche may submit to Plaintiffs a certification of completion from the Engineer of Record. Along with the certification, Belle Fourche shall submit all supporting documentation necessary to demonstrate that Elements 3 through 7 in the Remediation Work Plan have been completed.

a. If Plaintiffs disagree that any aspect of Elements 3 through 7 have been completed, or if Plaintiffs fail to respond to the certification of completion from the Engineer of Record within 90 days, Belle Fourche may invoke Dispute Resolution.

b. If Plaintiffs agree that Elements 3 through 7 have been completed, the Parties may file a joint stipulation terminating the requirements to perform Elements 3 through 7 in the Remediation Work Plan.

81. Request for Full Consent Decree Termination. Belle Fourche may serve upon Plaintiffs a Request for Consent Decree Termination after: (a) making all payments required by Paragraph 24 (Reimbursement of State Response Costs); (b) completing Elements 3 through 7 in the Remediation Work Plan; (c) achieving the Remediation Standards (or demonstrating the requirement to achieve the Remediation Standards is terminated pursuant to Paragraph 84); and (d) paying any accrued stipulated penalties as required by Section VII (Stipulated Penalties). The

Request for Full Consent Decree Termination must include all supporting documentation necessary to demonstrate that the requirements for termination have been met.

82. Following receipt by the United States and the State of the Request for Full Termination, the Parties shall confer informally concerning the Request and any disagreement that the Parties may have as to whether Belle Fourche has satisfactorily complied with the requirements for full termination of this Consent Decree. If the United States and the State agree that the Decree may be terminated, the Parties shall submit, for the Court's approval, a joint stipulation for termination of the Decree.

83. If the United States and the State do not agree that the Decree may be terminated, Belle Fourche may invoke Dispute Resolution under Section IX. However, Belle Fourche may not seek Dispute Resolution of any dispute regarding termination until 60 days after service of its Request for Termination.

84. Request for Termination of Remediation Standards. No earlier than five years after the Effective Date, Belle Fourche may seek termination of the requirement to achieve the Remediation Standards if it demonstrates that further remediation at the Site would be both:

a. Impracticable or infeasible; and

b. Levels of remaining hydrocarbons do not present an unreasonable risk to human health or the environment.

85. The Parties shall follow the same procedures in Paragraphs 81-83 to determine whether the conditions for early termination under Paragraph 84 have been met, or to seek Dispute Resolution.

XVII. PUBLIC PARTICIPATION

86. This Consent Decree shall be lodged with the Court for a period of not less than

30 days for public notice and comment in accordance with 28 C.F.R. § 50.7. The United States reserves the right to withdraw or withhold its consent if the comments regarding the Consent Decree disclose facts or considerations indicating that the Consent Decree is inappropriate, improper, or inadequate. Belle Fourche consents to entry of this Consent Decree without further notice and agrees not to withdraw from or oppose entry of this Consent Decree by the Court or to challenge any provision of the Decree, unless the United States has notified Belle Fourche in writing that it no longer supports entry of the Decree.

XVIII. SIGNATORIES/SERVICE

87. Each undersigned representative of Belle Fourche and the State, and the Principal Deputy Assistant Attorney General for the Environment and Natural Resources Division of the Department of Justice identified on the DOJ signature page below, certifies that he or she is fully authorized to enter into the terms and conditions of this Consent Decree and to execute and legally bind the Party he or she represents to this document.

88. This Consent Decree may be signed in counterparts, and its validity shall not be challenged on that basis. Belle Fourche agrees to accept service of process by email with respect to all matters arising under or relating to this Consent Decree and to waive the formal service requirements set forth in Rules 4 and 5 of the Federal Rules of Civil Procedure and any applicable Local Rules of this Court including, but not limited to, service of a summons.

XIX. INTEGRATION

89. This Consent Decree constitutes the final, complete, and exclusive agreement and understanding among the Parties with respect to the settlement embodied in the Decree and supersedes all prior agreements and understandings, whether oral or written, concerning the settlement embodied herein. Other than deliverables that are subsequently submitted and

approved pursuant to this Decree, the Parties acknowledge that there are no representations, agreements, or understandings relating to the settlement other than those expressly contained in this Consent Decree.

XX. APPENDICES

90. The following Appendices are attached to and part of this Consent Decree:

Appendix A: Remediation Work Plan

Appendix B: Map of the Ash Coulee Creek Remediation Site

Appendix C: Environmental Covenant

Appendix D: Monitoring Work Plan

XXI. 26 U.S.C. SECTION 162(f)(2)(A)(ii) IDENTIFICATION

91. For purposes of the identification requirement of Section 162(f)(2)(A)(ii) of the Internal Revenue Code, 26 U.S.C. § 162(f)(2)(A)(ii), performance of Section II (Applicability), Paragraph 4; Section V (Remediation Measures), Paragraphs 9-11, 13-19, and 24; Section VI (Reporting Requirements), Paragraph 25; and Section X (Information Collection and Retention), Paragraphs 54-58 are restitution, remediation, or required to come into compliance with law.

XXII. FINAL JUDGMENT

92. Upon approval and entry of this Consent Decree by the Court, this Consent Decree constitutes a final judgment of the Court as to the United States, the State, and Defendant.

Dated and entered this ___ day of _____, 2026.

_____
DANIEL L. HOVLAND
United States District Judge

The Undersigned Party enters into this Consent Decree in *United States and State of North Dakota v. Belle Fourche Pipeline Company.*

FOR THE UNITED STATES OF AMERICA

ADAM R.F. GUSTAFSON
Principal Deputy Assistant Attorney General
Energy and Natural Resources Division
U.S. Department of Justice

09/09/2026
Date

/s/ Mark C. Elmer
MARK C. ELMER
Senior Counsel
Environmental Enforcement Section
Energy & Natural Resources Division
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Tel: (202) 598-3319
Email: johanna.franzen@usdoj.gov

The Undersigned Party enters into this Consent Decree in *United States and State of North Dakota v. Belle Fourche Pipeline Company*.

FOR THE U.S. ENVIRONMENTAL PROTECTION AGENCY

MARK SMITH Digitally signed by MARK SMITH Date: 2026.08.28 14:29:03 -06'00'

Date

CYRUS WESTERN
Regional Administrator
U.S. Environmental Protection Agency, Region 8

KENNETH SCHEFSKI Digitally signed by KENNETH SCHEFSKI Date: 2026.08.27 16:52:32 -06'00'

Date

K.C. SCHEFSKI
Regional Counsel
Office of Regional Counsel
U.S. Environmental Protection Agency, Region 8

SUZANNE BOHAN Digitally signed by SUZANNE BOHAN Date: 2026.08.28 15:15:49 -06'00'

Date

SUZANNE J. BOHAN
Director
Enforcement and Compliance Assurance Division
U.S. Environmental Protection Agency, Region 8

ROBYN EMESON
Senior Assistant Regional Counsel
Legal Enforcement Branch
Office of Regional Counsel
U.S. Environmental Protection Agency, Region 8

The Undersigned Party enters into this Consent Decree in *United States and State of North Dakota v. Belle Fourche Pipeline Company*.

JEFFREY HALL
Assistant Administrator
Office of Enforcement and Compliance Assurance
U.S. EPA
Mail Code 2243A
1200 Pennsylvania Ave., N.W.
Washington, D.C. 20460

KELLY BRANTNER
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Office of Enforcement and Compliance Assurance
U.S. EPA
Mail Code 2243A
1200 Pennsylvania Ave., N.W.
Washington, D.C. 20460

The Undersigned Party enters into this Consent Decree in *United States of America and State of North Dakota v. Belle Fourche Pipeline Company*.

FOR THE STATE OF NORTH DAKOTA:

09/09/2026
Date

/s/Matthew Sagsveen
MATTHEW SAGSVEEN
(ND ID # 05613)
Assistant Attorney General
Office of Attorney General
500 North 9th Street
Bismarck, North Dakota 58501-4509
Tel: (701) 328-3640 | Fax: (701) 328-4300
Email: masagsve@nd.gov

The Undersigned Party enters into this Consent Decree in *United States of America and State of North Dakota v. Belle Fourche Pipeline Company.*

FOR BELLE FOURCHE PIPELINE COMPANY:

8/18/2026
Date

KEVIN COOK
General Counsel
PO Drawer 2360
Casper, WY 82602

APPENDIX A

REMEDIATION WORK PLAN

United States, et al. v. Belle Fourche Pipeline Company

Work Plan for the Final Remedial Action at the Belle Fourche Pipeline Company Crude Oil Spill Site Near Belfield, North Dakota

March 7th, 2025

Prepared for:

Belle Fourche Pipeline Company

PO Drawer 2360
Casper, WY
82602-2360

Prepared by:

Geomega Inc.
2585 Central Avenue, Suite 200
Boulder, CO 80301



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1 Introduction

This is the Workplan for the final remedial action to address the release of crude oil from a spill site near Bellfield, North Dakota (the "Site"), caused by the rupture of a pipeline owned by Belle Fourche Pipeline Company (BFPC), the "Release." The Release occurred in December of 2016 after a natural landslide impacted the buried pipeline. BFPC undertook emergency response actions in coordination with the Environmental Protection Agency (EPA) and the North Dakota Department of Environmental Quality (NDDEQ). Since then, BFPC has continued various remedial and monitoring activities at the Site, in consultation with NDDEQ, as discussed in more detail below.

This Workplan will be incorporated into a formal settlement agreement (or "Consent Decree") between the United States, on behalf of EPA, and the State of North Dakota, on behalf of NDDEQ, on the one hand, and BFPC on the other (collectively referred to here as the "Parties"), to resolve a dispute regarding the nature and scope of a final remedy to address soil, water, groundwater and any other contamination arising from the Release. This Workplan represents the Parties' agreement on the work necessary to achieve final remediation of the Site, and to obtain closure of the Site. The Parties recognize and agree that the terms of the Consent Decree govern when the Workplan work described herein is concluded and no longer required.

This Workplan supersedes any prior plan, proposal, or work, unless expressly otherwise stated in this document. All engineering and excavation aspects of this Workplan are subject to the approval of the Engineer of Record.

1.1 Site Background

In December of 2016, a slope failure occurred adjacent to a tributary to the Ash Coulee Creek in Billings County, North Dakota that resulted in the rupture of a transmission pipeline buried in the hillside (Figure 1-1). The failure resulted in contamination of surface and subsurface soil with petroleum hydrocarbons, including light non-aqueous phase liquids (LNAPL), also known as product, NAPL or free product.

Immediately following the failure, emergency response actions were taken, primarily *in-situ* burning of accessible oil in the Ash Coulee tributary and physical removal of surficial oil from December 15, 2016, to March 23, 2017 (Dhieux, 2018). A 20 ft deep sheet piling wall was installed between the toe of the slope and the creek, keyed into the subjacent Sentinel Butte clay unit to protect surface water from the Release. The barrier wall in its current condition has an expected service life of up to 165 years (RJH 2024b).

The slide consisted of 3-26 ft of overburden which moved along a layer of underlying sandy clay (Trihydro 2017 and 2024). While some water exists in perched zones, it is sporadic and discontinuous. The underlying impervious Sentinel Butte clay unit is continuous with isolated, thin lignite layers no more than 3 ft thick (Figure 1-2). The regional groundwater table is below the clay unit (~1,000 ft thick) intersected only by a 10 ft sequence at 425 ft above mean sea level (amsl), where water was encountered in a well screened across 1,672-1,735 ft below ground surface (bgs), northeast of the Site (Figure 1-3).

Following the emergency response, the hillside was regraded to reinforce the slope stability and control hydraulic movement through the overburden. During this activity in 2017, ~550 tons of soil containing an unknown amount of oil were removed from the Site and disposed of at the former R360 Chimney Butte landfill (Pers. comm. Scott Kerr).

A geotechnical survey in 2023 (RJH 2024a) and a slope stability analysis determined that while the factor of safety is 1-1.2 and the hillside is stable, the risk of slope failure would be exacerbated by excavation of remnant contaminated soil to a depth > 3 ft (RJH 2024b). The slope failure plane intersects the ground surface at ~2,496 ft above mean sea level (amsl) ~5-50 feet south of the sheet pile wall (Figure 1-1). This elevation is used to differentiate between the area uphill of 2,496 ft amsl (the “Upland Area) and the area downhill of 2,496 ft amsl (the “Lowland Area”). The geotechnical engineer also evaluated the service life of the sheet pile wall and estimated that, even in the absence of cathodic protection, it would continue to function as a hydraulic barrier for up to 165 years (RJH 2024b).

2 Site Investigation and Remediation Overview

Since 2017, Trihydro Corporation (Trihydro) has provided environmental services for the Site, including characterizing the soil conditions, reducing the residual subsurface LNAPL volume and implementing passive source zone reduction methods. Three soil sampling campaigns in 2017, 2018 and 2023 resulted in 46 boreholes. Installations include 13 turbine vent wells, 30 air entry wells and 13 *in-situ* chemical oxidation (ISCO) wells (that deployed H_2O_2) on the ~3.5-acre hillside (Figure 2-1). Vent wells were also established around the Site to provide sufficient air transfer into the injection wells. To promote air flow through the system, 12-inch by 12-inch wind turbines were installed on the surface. Thirty air entry wells were established to provide inlet air, and surface casings were fitted with 90-degree elbows to prevent intrusion of debris.

LNAPL was retrieved from the ponds behind the wall from 2018 through 2021, after which it no longer appeared. LNAPL is also pumped from hillside wells using a vacuum-enhanced fluid extraction (VFE) system, where a drop tube is inserted to the oil-water interface and the product pumped to a vacuum truck.

Between October 23 and November 5, 2017, nearly 6,300 gallons of 15% hydrogen peroxide (H_2O_2) were introduced to the subsurface through 13 injection wells and selected vent wells (Trihydro 2018). Hydrogen peroxide concentrations, fluid elevation, and temperature were regularly monitored to assess microbial activity and the radius of impact of the hydrogen peroxide injections on natural source zone depletion (NSZD). ISCO injections had limited ability to treat impacted soil due to the LNAPL which consumed the oxidant, with H_2O_2 also short-circuiting and surfacing on the hillside.

In 2019, 35 bore holes in transects were monitored using the downhole ultraviolet optical screening tool (UVOST) and the hydraulic profiling tool (HPT) to determine if LNAPL recovery might be feasible at the northwest area of the Site, resulting in a proposed removal plan. Subsequently, existing wells were chosen to introduce Tersus 2.1% TASK™ (a surfactant) to promote the mobility and enhanced extraction of LNAPL. A subsequent injection/recovery event using the same surfactant was completed in June 2022. However, this approach was also largely unsuccessful, with the estimated LNAPL volumes recovered

during three 2020 pre-pilot test extraction events amounting to ~19 gallons (June), 6½ gallons (July), and 21 gallons (August), while two post-pilot test extraction events resulted in retrieval of ~2 and 2.5 gallons in November and December, respectively.

Microbial activity and rates of degradation were assessed by monitoring the levels of CO_2 at 28 (2017) and 40 (2018 and onward) efflux locations. Several locations are outside of the impacted soil region, and in conjunction with the CO_2 efflux from impacted areas, routinely indicated that ongoing bioremediation (NSZD) was occurring.

To support the bioremediation of free product, oleophilic biobarriers (OBBs) were installed in four areas at the toe of the slough surrounding LNAPL seeps. These barriers were designed to promote biological degradation of free product and prevent migration of hydrocarbons, while allowing the transport of other soil constituents such as water and gases.

The Ash Coulee Creek (2 miles downstream from the Site) and a tributary to the creek (adjacent to the Site) are monitored monthly (Figure 2-2) previously by Keitu Engineers & Consultants, Inc. and currently by Meadowlark Environmental, LLC for temperature, dissolved oxygen, conductivity, oxidation-reduction potential, pH, hydrogen peroxide, volatile organic compounds and TPH.

3 Conceptual Site Model (CSM)

Saturation of a fluid within a geologic medium, i.e., the ratio of the fluid volume (V_f) to the volume of pore space (V_m) within the medium (V_f/V_m), ranges from 0 to 100%. The saturation may be less than 100% for each given fluid element if the pore space in the geologic media is occupied by multiple fluids (e.g., LNAPL, water, and/or air). The composition and distribution of the fluid elements, and therefore their saturation and mobility, are determined by the fluid's properties (i.e., specific gravity, viscosity, interfacial tension, and wettability), medium properties (i.e., pore space configuration and size, capillary forces), and pressure history (i.e., head and infiltration).

Following the release of LNAPL into the subsurface, the free product migrates downwards through the soil profile until it reaches a depth where it becomes immobilized (Figure 3-1) due to capillary forces in the soil and is retained in the pore space (Davis 2024). Typically, water is the wetting fluid in direct contact with the soil and occupies the smaller pores. LNAPL must; therefore, displace the water (and gases) within a pore space before it can migrate.

For this to occur, it must have a driving head and overcome the capillary pressure exerted by the water in the pore. The boring logs reflect the level of LNAPL saturation identified in each borehole (Figure 3-2), i.e., 1) saturated, which connotes a mobile LNAPL where the occluded porosity is ~70%, 2) blebs, ganglia and lenses (BGL) coating soil grains that is disconnected and discontinuous, with a residual porosity of 20-30% where LNAPL is immobile, and 3) stains and sheens (SS).

Following the Release at the Ash Coulee Site, some LNAPL migrated in preferential flow paths to the wall where it collected on the surface of the ponds until it was physically removed. It also accumulated in the upslope temporary well annuli where it was pumped out on a regular basis. Over time, the driving head decreased, so that after 6 years no more product (or sheen) was reporting to the pools because the upslope LNAPL had reached the BGL stage.

However, spring precipitation resulted in introduction of water into the vadose zone resulting in water wetting of BGL-bearing pore space adjacent to temporary wells and the displacement of LNAPL into the wells. As water in the vadose zone evaporated during summer, there was less displacement of LNAPL, resulting in a lower product removal than in the spring.

The light end (C^{6-12}) petrochemical compounds biodegrade readily to carbon dioxide and water in the subsurface, i.e.,

$$2\ C_8H_{18} + 25\ O_2 \rightarrow 16\ CO_2 + 18\ H_2 \qquad \text{(Eq. 1)}$$

while polar molecules also degrade to non-polar alcohols, esters, aldehydes and ketones that, while not petrochemical compounds, are also analyzed as TPH unless the sample undergoes a preliminary silica gel cleanup.

The CSM anticipates that, following physical removal of product in 2017, there would be an initial migration of remnant LNAPL in the soil profile downslope to the wall until a steady-state residual saturation condition was reached, at which point, accumulation on the ponds would cease. Similarly, LNAPL in the vicinity of the upslope temporary wells would accumulate in the annuli, but with ongoing removal, the volume would diminish over time as inventory was depleted. Ongoing petroleum hydrocarbon reduction in the vadose zone would be anticipated due to the volatility and well understood biodegradation mechanisms for this class of compounds.

4 Results of Ongoing Remediation

4.1 Soil

Sampling campaigns in 2017, 2018 and 2023 allow a comparison of the GRO and DRO concentrations after 6 years of remediation at the Site. In 2017/18, TPH GRO (n =22) had an average of ~3,450 mg/kg with 10 non-detects (Figure 4-1). In 2023 (n = 70), the average was 1,535 mg/kg with 20 non-detects. In 2018[1] TPH DRO (n =6) averaged 7, 330 mg/kg with 1 non-detect, while in 2023, 59 measurements averaged 1,300 mg/kg with 1 non-detect (Figure 4-2). Between 2018 and 2023, there was a decrease in GRO and DRO of 55% and 82%, respectively. This pattern of decreasing TPH comports with the CSM in that soil concentrations have decreased due to ongoing removal actions and natural biodegradation of DRO and GRO.

4.2 Free Product

LNAPL has been collected from behind the wall and open borings on the slope since January 2018. The last recovery from behind the wall was in 2021 with volumes consistently decreasing from 23.6 barrels (bbl.) to ~24 bbl in 2018, 16.8 bbl. in 2019, 5.4 bbl. (~225 g) in 2020 and 1 bbl. (~40 gallons) in 2021, with no subsequent recovery thereafter (Figure 4-3[2]).

The temporary well removal profile (Figure 4-4) differed, in that while it too decreased by 93% since 2018 from an annual recovery of 6 bbl to 0.4 bbl. in 2024 (Figure 4-3), the removal increased in 2022 between January and September, before subsequently decreasing. The minimal increase in the 2022 recovery from the wells is potentially due to the wetter year which would, consistent with the CSM, have enhanced water wetting and slightly increased LNAPL mobilization in the vadose zone. These recovery trends are consistent with the CSM which predicts decreasing recoveries over time as the original product volume is removed, and a residual saturation condition prevails, in conjunction with ongoing weathering and biodegradation.

[1] In 2017, DRO analyzed by DRO as Diesel for n =33 averaged 4,200 mg/kg with 8 non-detects.
[2] The additional undifferentiated volume represents NAPL combined from behind the wall in addition to that recovered from wells but for which no record was kept of its source location.

4.3 Biodegradation

The degradation of LNAPL by microorganisms is an oxidative process that releases electrons balanced by concurrent reduction reactions (ITRC 2018). Hydrocarbon biodegradation has been established as effective and is frequently used for similar sites (NDDEQ 2023a) which states, "*Land treatment of wastes can be effective when approached scientifically, using naturally occurring soil microorganisms to biodegrade petroleum. Some volatilization of petroleum hydrocarbons will also occur during the process*."

In the subsurface, favorable thermodynamic conditions result in oxygen being reduced as a terminal electron acceptor, generating carbon dioxide (CO_2). Under anaerobic conditions denitrification and methanogenesis can occur, though these compounds will also subsequently undergo reduction to form CO_2 (ITRC 2018). Therefore, the rate of CO_2 release from the soil is an indicator of the LNAPL biodegradation rate.

Since 2017, the CO_2 efflux rate was compared between impacted and unimpacted areas and the difference used to calculate the LNAPL biodegradation rate, ranging from ~20 bbl. in 2019 to ~120 bbl. in 2021 (Figure 4-5). During 2022, cold, wet conditions limited microbial activity in the soil and subsurface constraining LNAPL biodegradation to ~40 bbl.; however, in 2023 with more favorable conditions, > 70 bbl. were biodegraded. These data comport with the CSM which identifies ready biodegradation of residual petroleum hydrocarbons in this setting.

4.4 Surface Water

Surface water samples from the tributary to (at the downgradient Site boundary) and in Ash Coulee (Figure 2-2) have been analyzed since July 2017. Benzene, toluene, ethylbenzene and xylene (BTEX), together with TPH were compared against their relevant human health and ecological risk standards (Table 4-1). The results demonstrate that over the last 4 years BTEX have all been well below the more stringent standard of the two (and typically below the detection limit), while TPH is more than 3 orders of magnitude below North Dakota's Risk-Based Corrective Action Levels (Figures 4-6 through 4-10).

5 Current Remedial State

The residual LNAPL resides in pore space as BGL and remains immobile, leaving little opportunity for alternative methods of LNAPL recovery/degradation. Ongoing biodegradation is apparent from the change in concentrations of DRO in the soil and changes in the amount of DRO relative to GRO between 2017 and 2023, indicating that heavier hydrocarbons are being degraded into lighter polar compounds that more readily volatilize from the soil. This condition is further supported by the dissipation of GRO as CO_2 through bioremediation in the subsurface.

Overall, the Site has reached a steady-state condition in terms of free product removal. For example, 1) LNAPL in the ponds behind the sheet piling is no longer detected, 2) free product recovery in 2024 was only 7% of that in 2018, 3) soil GRO and DRO TPH average concentrations declined by 55% and 82%, respectively between 2018 and 2023, and 4) BTEX and TPH have remained below the most stringent standards in the Ash Coulee surface water over the last four years. While biodegradation of LNAPL adsorbed to the soil and trapped in pore spaces remains ongoing, TPH has, and is degrading to CO_2.

An 8-Element plan was developed that is intended to, 1) ensure worker safety during removal of surficial contamination and remnant product that may reside behind the wall, 2) install surface water erosion controls and cathodic wall protection to further stabilize the Site, even as, 3) natural attenuation continues.

6 Final Remediation Workplan

The remaining hydrocarbons in the hillside are stable and degrading in place. LNAPL has not been recovered from the collection ponds since 2021, while only 11 gallons of free product were recovered from the wells in 2024. The hillside and sheet pile barrier wall are stable, with the current barrier wall having an expected service life of up to 165 years in the absence of cathodic protection (RJH 2024b). Surface water samples downstream have not been impacted by BTEX or DRO over the last ~4 years, attesting to the efficacy of the barrier wall. The Elements of the final remedial action (Figure 6-1) are described below and their data quality objectives (DQO's) identified in Table 6-1.

6.1 Element 1: Existing Remediation

Ongoing remediation to be continued under this Workplan will be identical to, and no greater than, the following current remedial activities conducted by existing site remediation and sampling contractors (Trihydro and Meadowlark Environmental, LLC), and as further defined and limited by activities identified in this Workplan., i.e.:

- Tributary monitoring
- LNAPL gauging in temporary wells
- LNAPL removal from temporary wells
- CO_2 efflux monitoring, and
- Site maintenance

Monitoring for, and removal of LNAPL occurs at a minimum once at the beginning of each field season and once at the end of the field season (Table 6-2). This duration between recoveries is necessary to allow enough product to accumulate in the well annulus between each extraction event. The "*dynamic in nature*" LNAPL recovery from Site wells has been implemented successfully since initial remediation efforts; therefore, while adaptation to optimize recovery is to be anticipated and expected, the proposed minimum two gauging and recovery events in a field season has been met, or exceeded, since the onset of remediation.

The Site wells (Figure 2-1) which are not blocked or underwater (Table 6-2) will be gauged for product thickness in accordance with the procedures initially proposed by Trihydro (2018, Attachment C) and most recently followed by Trihydro (2025).

LNAPL recovery will be completed in accordance with previous methods at the Site (Trihydro 2018). Specifically, recovery will be with a ½ inch downhole "Stinger" suction tube and vacuum-enhanced fluid extraction (VFE), both of which rely on suction from a vacuum truck. The most appropriate method for removal will be determined in the field by the supervising party. Disposal will be consistent with previous activities. Sheens and stains on the probes or odors from the well are not recoverable LNAPL and blocked wells will not be replaced as part of this element.

NSZD, which was initiated in 2018, will decrease hydrocarbon mass and will continue to be monitored by annual CO_2 efflux sampling (Table 6-3). NSZD sampling will follow ITRC (2018) guidelines (Appendix B – Natural Source Zone Depletion) using the dynamic closed chamber method. Locations at which CO_2 efflux has been measured previously (2018 to present) will continue to be used to allow for consistent evaluation of trends at the Site (Table 6-3). The dynamic closed chamber will be used in accordance with prior practices at the Site (Trihydro 2018, Attachment C), involving repeated measurements in the morning and afternoon at each location after GPS confirmation. These data will be used to calculate the ongoing hydrocarbon degradation rate in accordance with ITRC (2018) guidelines.

In addition to fluid gauging, LNAPL removal and NSZD activities, the contractor will also inspect the Site for remedy integrity purposes, as is currently done each field season.

6.2 Element 2: Investigation Phase

Field documentation for the investigation phase will be consistent with the Field Documentation SOP (Appendix A) and sampling methodology in accordance with the Soil Sampling Workplan (Appendix B).

6.2.1 Lowland Area

The Lowland Area will be investigated at the locations identified on Figure 6-2 and excavated in the areas where TPH concentrations exceed 500 mg/kg, with the vertical extent ending at the Sentinel Butte clay.

6.2.1.1 Indications and Locations of Impacted Lowland Soil

There are currently no wells or boreholes in the immediate vicinity of the sheet pile wall (Figure 2-1). The wall was installed in 2017 and while both LNAPL and TPH are decreasing and stable, LNAPL saturation was high enough to allow mobility prior to 2022 as evident from the recovered LNAPL in the ponds in 2018 through 2021. Conceivably, some of the LNAPL did not seep into the ponds but may remain trapped behind the wall at depth.

The installations nearest to the wall are V-01 and V-03 (Figure 2-1) and have historically had~6 ft of product, although these numbers have diminished since 2022 to 2 ft and 0.2 ft of product thickness in 2024, respectively. The extent of residual LNAPL and TPH impacts (if any) juxtaposed against the wall will be the subject of an investigation with boreholes near the wall (after the ponds have been dewatered and there is safe access).

6.2.1.2 Investigation of Potentially impacted Lowland Soils

The UVOST technique, as deployed successfully in 2019, was initially considered and presented to NDDEQ for this investigation. UVOST would give high resolution LNAPL saturation data; however, discussions with the NDDEQ resulted in a TPH standard of 500 mg/kg TPH behind the wall in the Lowland area. UVOST does not provide a TPH value and is, therefore, excluded from this investigation. Instead, core samples analyzed for TPH will be used to delineate contamination.

The lateral extent of the investigation will be from the interior of the sheet pile wall (uphill side) to at most 50 ft south-southeast of the wall to avoid intersecting the modeled failure plane (RJH 2024b; Figure 7) at ~2,496 ft above mean sea level (amsl), representing the upper bound of the Lowland Area investigation. The investigation will use a sampling grid (Figure 6-2) and follow the methods in the Drilling Oversight and Soil Sampling SOP (Appendix B) for safe and proper usage of a direct push rig. The sampling grid is ~25ft on center with

minor adjustments to include additional points that lie outside, but adjacent to the investigation area, and overlapping prior boreholes for temporal data comparison.

The ponds will be drained, and minor regrading/filling may occur if necessary, so that a direct push rig (similar to that previously used at the Site) has safe access to the Lowland Area. The Sentinel Butte clay, anticipated to be intercepted at ~5-17 ft below the surface, will constrain the sampling depth behind the wall, with more precise depths predicted from the interpolated clay surface (Table 6-4). The depth to top of the Sentinel Butte and soil moisture conditions will be recorded at each location. At each location, a 5-foot core will be collected through the profile down to the clay unit, each core split into two equal halves (2.5 ft long) and composited. A PID reading will be collected from an aliquot of soil and the sample analyzed for TPH by Massachusetts Department of Environmental Protection (MADEP) Volatile Petroleum Hydrocarbons (VPH) and Extractable Petroleum Hydrocarbons (EPH). A single TPH value will be calculated from the sum of the unadjusted C5-C8 Aliphatic, C9-10 Aromatic, C9-C18 Aliphatic, C11-C22 Aromatic, and C19-C36 Aliphatic fractions from the two analyses, with non-detects excluded from the sum. This TPH calculation method encompasses the entire C5-C36 carbon range. The results of the investigation will be used to determine the extents and volume of contaminated material requiring removal.

6.2.2 Upland Area Surficial Soils

The Upland Area will be investigated at ten discrete locations where the PID readings exceeded background. If soil TPH concentrations exceed 500 mg/kg , these areas will be excavated and constrained laterally to the interpolated extent within the sampling grid, with the vertical extent ending at three feet bgs. See Section 6.3 for full details.

6.2.2.1 Indications and Locations of Impacted Surficial Soil

While there is an extensive body of PID screening data (in 2017 and 2023) and UVOST (2019) data from prior installations and investigations, TPH data at depths < 3 ft bgs are sparse. Therefore, the PID screening data were used to identify locations of potential hydrocarbon impact at < 3 ft to delineate locations for TPH laboratory analysis.

There is a large surficial PID dataset (66 locations with 493 measurements, 106 of which are from the upper 3 ft) that captures the extent of the surficial impacts. PID readings taken

during advancement of the boreholes are a reliable indicator of surficial soil contamination because the readings were taken at short intervals in each borehole (~2ft) starting from the surface. PID readings in 2023 collected from 25 borings (Trihydro 2024) typically measured values of 0 in the top 3-5 ft (Table 6-5), except at four locations (509 ppm in DP-2023-9, 343 ppm in DP-2023-24, and 920 ppm in DP-2023-20, and 88.1 ppm in DP-2023-26).

PID readings in 2017 and 2018 identified 9 additional locations where background (7.3 ppm[3]) was exceeded; however, over the last 6 years, degradation by volatilization and biodegradation has been ongoing. Therefore, areas where the 2023 bore was co-located with a 2017 or 2018 bore default to the 2023 data, resulting in an additional 6 impacted areas from this dataset (Table 6-5).

The 2019 UVOST analysis identified four boreholes with LNAPL impacts in the top 3 ft. Three of these locations (SB-02, SB-06, and SB-21) are superseded by the 2023 borehole dataset with background PID levels in 2023 (Table 6-5). A single UVOST location, SB-33, had a signal of 36%, potentially indicative of LNAPL impacts at that time, above the 25% impact criterion. Finally, the single TPH lab analysis of a soil sample from the top 3 ft in DP-2023-01 (at 2.5 ft bgs) resulted in a TPH value of 9060 mg/kg (Table 6-5).

The Site dataset identified 12 candidate locations with potentially impacted surficial soils (Figure 6-3). However, 2 of these locations overlap with the Lowland investigation behind the wall (Figure 6-3) and will be addressed by that investigation, resulting in 10 remnant locations (Figure 6-4). The potential surficial impacts are bound by the locations where the PID data was below background. Accordingly, polygons were drawn to delineate the maximum lateral extent of the excavations (Figure 6-5).

[3] Based on 3 boreholes uphill or cross gradient from the pipeline rupture and outside of the lateral extent of impacted soils in DP-14, DP-15, and DP-16 (Trihydro 2017). This level is consistent with other background PID levels for projects in North Dakota of 10 ppm (Braun Intertec 2016).

6.2.2.2 Investigation of Potentially Impacted Surficial Soils

There are 10 locations in the Upland Area subject to removal (8 locations due to elevated PID readings, 1 location due to elevated UVOST signal and 1 location due to an elevated TPH lab analysis). To determine the areas constrained by 500 mg/kg TPH and given the lack of TPH data in these areas, a preliminary soil sampling exercise will be necessary to determine the areas to be excavated to 3 ft within the delineated polygons (Figure 6-5). At each area, 4 samples will be collected from the north, south, east and west quadrants at 10 ft laterally from the elevated PID location and another set at a 20 ft lateral distance along each axial plane (Figure 6-4). These distances were selected as representative of half the distance to an adjacent historical non-detect PID value.

At each location (Table 6-6), the three-foot sample will be collected using a direct push rig, the material composited, and a single subsample collected. A PID measurement will be collected from the subsample soil aliquot and the soil analyzed for TPH by MADEP VPH and EPH. A single TPH value will be calculated from the sum of the unadjusted C5-C8 Aliphatic, C9-10 Aromatic, C9-C18 Aliphatic, C11-C22 Aromatic, and C19-C36 Aliphatic fractions from the two analyses, with non-detects excluded from the sum. This TPH calculation method encompasses the entire C5-C36 carbon range.

6.2.3 Phase I Waste Management and Other Contingencies

The leftover soil from the investigation will be disposed of in accordance with the Drilling Oversight and Soil Sampling SOP (Appendix B), including proper decontamination processes. The Emergency Action Plan SOP (Appendix C) and the Health and Safety Plan (Appendix D) will be strictly adhered to for all Site activities.

Level 2 data packages from the laboratory TPH analysis will be reviewed for quality assurance and quality control.

6.2.4 Phase I Reporting

Following collection of the Lowland and Upland confirmation TPH data, it will be necessary to interpret the data and provide a report to the Engineer-of-Record. He/She will develop

engineering drawings of the excavations required by this workplan and soil replacement in each area, taking into consideration the stability of the slope.

6.3 Element 3: Excavation

6.3.1 Remove and Replace Material Behind the Wall: Lowland Area

The depth of excavation will extend to either, 1) the depth of the deepest nearby sample with TPH >500 mg/kg, or 2) the Sentinel Butte clay formation, whichever is encountered first. The excavation will occur in segments to address destabilization of the wall and/or hillslope, with the lateral extent also guided by the TPH results from Phase I. The southern (uphill) extent of the excavation will be no further than the modeled failure plane (~2,496 ft amsl) (RJH 2024b; Figure 7), consistent with the bounds of the investigation phase (Figure 6-2). Excavation will be large enough so that the fluid management system (Element 5) can be properly installed.

The size of each excavation segment will be specified based on the Phase I TPH testing results and stability evaluations using the models and material properties described by RJH (2024a). The evaluations will consider the stability of the regraded slope (Upland area) south of the Lowland Area, the soil moisture conditions and the stability of the sheet pile wall. The soil moisture conditions in the Lowland Area have not been well documented because of limited access for investigation in the past. However, soil is expected to be wet to saturated in the vicinity of the existing ponds. Therefore, dewatering may be needed to safely excavate the material in the wet areas.

Soil moisture conditions in the Lowland Area will be documented during the investigation phase (Element 2). In the regraded slope these are typically lowest in late summer and early fall which would be the optimum time to excavate the Lowland Area because low soil moisture increases the stability of the regraded slope. The extent of each excavation segment will be limited to prevent destabilizing the slope and the wall

Clean backfill extending to the top of the sheet pile wall will be placed in the excavation (or on the native soil if not excavated), eliminating the collection ponds. Backfill will be

compacted and graded towards the creek to eliminate water ponding, thereby reducing infiltration and allowing surface water to flow directly to the creek.

The clean backfill will be compacted to achieve the required strength properties, to reduce its permeability, and thereby reduce the amount of infiltration that will need to be collected by the fluid management system (Element 5).

6.3.2 Remove and Replace Upland Material

The Upland excavation will be delineated subsequent to the Phase I investigations. Contaminated soil (>500 mg/kg TPH) at the Phase I investigation locations will be excavated within the polygons depicted on Figure 6-5 and disposed at the Chimney Butte landfill or another permitted facility. After the lateral extents of required excavation are determined from the Phase I results, Engineer of Record will evaluate the stability of the regraded slope and delineate specific excavation segment boundaries and general maximum excavation sizes that can be safely excavated to a depth of 3 ft. Stability evaluations will be run using the models and material properties identified by RJH (2024a) and will consider the global stability of the regraded slope and the stability of the excavation segments for worker safety.

Segment sizes will be limited so excavation does not destabilize the slope and so excavations can be backfilled within a few hours in the event of an impending rain event. Limiting the excavation segment sizes so they can be backfilled quickly is important because rapid infiltration during a rain event could destabilize the overall regraded slope; therefore, clean backfill stockpiles will be maintained close to the excavation to facilitate rapid backfilling. Soil moisture conditions in the regraded slope are typically lowest in late summer and early fall which would be the optimum time to excavate the Upland Area because low soil moisture increases the stability of the regraded slope.

The soil will be replaced with clean backfill and clean topsoil either from the hillside on the north side of the creek or imported as clean fill. The clean backfill will be compacted to achieve the required strength properties and to reduce infiltration.

6.4 Element 4: Run-off Controls

More robust runon/runoff controls will be implemented with the goal of, 1) routing overland flow directly into the stream around the north and south ends of the wall, 2) reducing infiltration into the hillside, 3) reducing the potential for mobility of remnant petroleum hydrocarbons and LNAPL, 4) improving slope stability (RJH 2024b), and 5) reducing the frequency at which the sump (Element 5) must be drained.

Runoff controls will consist of cross-slope ditches graded into the regraded slope. Ditches are expected to be about 1 foot deep on the downhill side and 2 or 3 ft deep on the uphill side. The ditches will slope gently from the center of the regraded area towards each side. There are already minor cross-slope ditches on the hillside which were installed during regrading of the slope that will be bolstered and altered as necessary. The cross-slope ditches will flow into collection ditches on both sides of the regraded area that will convey the collected, unimpacted, surficial water to the creek (Figure 6-6). The cross-slope and collection ditches will be sized and armored, if necessary, to greatly minimize erosion.

Cross-slope ditches are planned at the top of the regraded slope above the modeled failure surface (RJH 2024b), at one or more locations mid-slope and near the toe of the slope, but above the 500-yr/24 hr. storm event level (2,503 ft amsl). The upper location will capture run-on from above the regraded/impacted areas from reaching the regraded slope, reducing the potential for saturation of the head of the former slide. The lower location will reduce infiltration in the Lowland Area by directing runoff from the slope directly to the creek. One or more mid-slope ditches will prevent the surface water flow from initiating erosion, reduce infiltration and keep the lower ditch from being exceedingly large.

6.5 Element 5: Install a Fluid Management System

As initially discussed with NDDEQ, a passive funnel and gate technology using granular activated carbon cassettes in the “gate” would allow discharge of treated water to the stream. This system would require pilot testing to design the proper filter material for the gate and monitoring of the effluent. In lieu of the funnel and gate, a more protective and expeditious alternative utilizing sumps is proposed, the Funnel and Sump System.

Sumps which collect infiltrated water moving down the slope are more protective of the environment because there will be no discharge to the Ash Coulee tributary. The sumps will be drained at intervals and the fluid disposed appropriately. The backfill to the top of the wall and runoff controls (Elements 3 and 4) aim to minimize the volume of infiltrated water, thus, the rate of filling of the sumps is not anticipated to be rapid. However, if circumstances change, (e.g., multiple 500-year floods), other fluid management alternatives may be considered.

During excavation and backfilling of the Lowland Area behind the sheet pile wall, drainage features will be included which direct the infiltrated water into the sumps (Figure 6-7). These features are conceptualized as a combination of chimney drains (either prefabricated or permeable sand) and perforated drainpipes encased in gravel that is one foot thick on all sides of the pipe. A drainpipe will be placed along the southern extent of the Lowland area excavation to collect subsurface water migrating from the regraded slope and convey the water to the sumps. The configuration of this drainpipe will be determined based on the extents of excavation and backfill in the Lowland Area.

A second drainpipe is envisioned along the middle of the Lowland Area to collect precipitation infiltration and convey this water to the sumps. A vertical chimney drain will be placed adjacent to the sheet pile wall that allows for flow along the plane of the installation to collector pipes that will convey collected water to the sumps. The chimney drain will collect water migrating towards the creek and will also expand wall longevity by reducing soil moisture on the interior side of the wall.

The basal elevation of the drainage features will be set at approximately the elevation of the creek to intercept subsurface water before it reaches the creek without creating a backwards gradient from the creek to the drain. Drain piping will be sized to convey collected seepage to the sumps *via* gravity at no more than half full. This will provide additional capacity to accommodate the potential for more concentrated seepage in some areas. The drainage features initially will only collect percolating precipitation from above and reduce water buildup behind the wall; however, the features will also capture any saturation build-up due

to the impermeable sheet pile wall during prolonged wet periods. The latter concept will help mitigate the surface expression of potentially impacted infiltration migrating from upslope.

Two sumps will be constructed (one each in the general vicinity of the existing ponds) that will result in wide catchment areas. The sumps will be partially dug into the clay so they are below the creek elevation and can collect seepage in the Lowland area by gravity (Figure 6-7). Sumps will be sized so pumping is infrequent. The storage volume will be calculated based on published infiltration rates for the soil types, the final slope angles (less infiltration occurs on steeper slopes), and the average annual precipitation at the Site.

Water levels in the sumps will be measured by telemetry to allow removal and disposal of oily water at necessary intervals. Sumps will have a single vertical access pipe which will provide access to the sumps from the surface but may require an additional (smaller diameter) port to allow for air pressure equalization during fluid removal. Within the sumps, float switches at 50%, 75%, and 90% full will be installed that will send a signal to the on-site solar powered computer to notify the Site management consultant. The sumps will be drained with a vacuum truck when they approach capacity, and the fluid will be properly disposed.

6.6 Element 6: 500-yr Riprap Flood Protection

This element must be robust enough to withstand creek flow resulting from a 500-yr/24-hr storm which could result in water elevations at ~2503 ft amsl (RJH 2024b), overtopping the barrier wall. The existing wall will address erosion of the backfill (which will extend to the top of the wall) to a minimum elevation of ~2487 ft amsl, while above the wall, the base of the Upland will be protected by riprap at ~2503 ft amsl, addressing stormwater erosion (Figure 6-8). Final hydraulic modeling will be undertaken to confirm the flow elevation of the 500-year storm after the final grading plan is developed for backfill of the Lowland Area behind the sheet pipe wall.

Riprap is used to address stream erosion because the weight of properly sized riprap blocks prevents their movement by flowing water. The riprap gradation used for the 500-yr flood protection will be designed to resist the velocities calculated in the final hydraulic modeling.

The thickness of the riprap will be 1.5 times the diameter of the largest riprap blocks and placed on geotextile fabric to minimize migration of the underlying soil through the riprap.

6.7 Element 7: Cathodic Wall Protection

Adding passive cathodic protection to the sheet pile wall is necessary to reduce the corrosion rate. Currently, the expected lifespan of the wall is up to 165 years (RJH 2024b), which will be extended by the addition of cathodic protection, constituting sacrificial anodes placed on both sides of the wall that will not require external electrical power (Figure 6-9). The size of the anodes will be developed based on the soil chemistry (resistivity and pH) and the replacement frequency determined by the design engineer.

6.8 Element 8: Monitoring

There will be ongoing monitoring of the following components as of the date of this Workplan. In addition, sump monitoring will occur as discussed in Section 6-5. The monitoring will include:

- Tributary monitoring,
- LNAPL gauging in temporary wells,
- LNAPL removal from temporary wells,
- CO_2 efflux monitoring,
- Sump cleanout, and
- Site maintenance

The duration of the monitoring is subject to the terms of the Consent Decree.

7 Schedule

The schedule anticipates, 1) sample collection during the summer/fall of 2025 with the Phase I report to the Engineer of Record by the close of Q4 2025, 2) engineering design for Elements 3 through 7 by the end of Q1 2026, and 3) execution of Phase II during the 2026

field season. The schedule is subject to change based on regulatory review and site conditions.

8 References

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Tables

Table 4-1. North Dakota human health risk-based screening levels and ecological risk standards.

Compound	Human Health Risk Levels (NDRBCA 2023)	Ecological Risk Levels (Various)
Benzene	5 µg/L	46 µg/L (EPA Ecotox 1996)
Ethylbenzene	700 µg/L	7.3 µg/L (ORNL Ecorisk 1996)
Toluene	1,000 µg/L	9.8 µg/L (ORNL Ecorisk 1996)
Xylene	10,000 µg/L	1.8 µg/L (EPA Ecotox 1996)
TPH	500 mg/L (500,000 µg/L)	

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Table 6-1. Summary of final remedy Elements and associated DQOs.

Element	Name	Data Quality Objective
1	Continuation of Existing Remediation	Monitor for and recover mobile NAPL, bioremediate immobile NAPL/TPH
2	Investigation Phase	Delineate TPH > 500 mg/kg in the upland surface soils (3ft) and the lowland soils to clay where TPH > 500 mg/kg
3	Excavation	Remove and replace soils identified in Element 2 with TPH >500 mg/kg. Backfill to the top of the wall and remove ponds.
4	Run-off controls	Install run-on/run-off controls to divert stormwater off the hillside and limit infiltration
5	Install a fluid management system	Install a sump system to replace the ponds to manage infiltration behind wall and extend the wall life.
6	500-yr flood protection	Install rip-rap to prevent erosion and destabilization of the toe of the hill under the design storm event (500-yr, 24-hr)
7	Cathodic Wall Protection	Install sacrificial anodes on the sheet pile wall to prevent corrosion and extend the wall life.
8	Monitoring	Continue ongoing remediation, monitor for final remedy integrity.

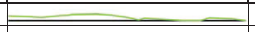
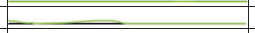
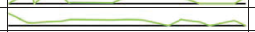
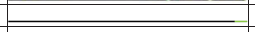
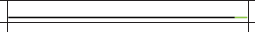
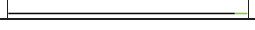
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Table 6-2. Ongoing NAPL gauging and recovery locations, DQOs and monitoring frequency with NAPL thickness trends shown on sparklines.

Location Name	Location Type[1]	Easting[2]	Northing[2]	Ground Elevation (ft amsl)	Stickup (ft)	Total Depth (ft btoc)	NAPL Thickness Trends	Well Status 9/2024	DQO	Frequency
AE-01	Air Entry Well	1254325.2	537849.8	2503	2.3	17.1			Measure for and Recover NAPL	Gage and Recover at a minimum 2 times during a field season
AE-02	Air Entry Well	1254384.8	537851.07	2520	2.25	19.7				
AE-03	Air Entry Well	1254326.9	537815.48	2510	2	19.7		Blocked @ 13.62 ft btoc		
AE-04	Air Entry Well	1254393	537819.5	2525	2.22	24.3				
AE-05	Air Entry Well	1254297.9	537790.37	2504	2.18	19.68		Blocked @ 12.29 ft btoc		
AE-06	Air Entry Well	1254359.5	537801.29	2522	2	19.7				
AE-07	Air Entry Well	1254425	537800.71	2531	1.84	26.32				
AE-08	Air Entry Well	1254456.5	537781.21	2537	2.02	31.35		Blocked @ 18.83 ft btoc		
AE-09	Air Entry Well	1254165.1	537746.7	2499	2.9	17.2				
AE-10	Air Entry Well	1254214.8	537741.2	2500	2	19				
AE-11	Air Entry Well	1254264.9	537734.53	2510	2.1	17.62		Blocked @ 15.26 ft btoc		
AE-12	Air Entry Well	1254296.8	537753.3	2512	2.21	19.8		Blocked @ 14.24 ft btoc		
AE-13	Air Entry Well	1254329.3	537739.71	2522	1.75	21.25				
AE-14	Air Entry Well	1254363.2	537757.79	2526	1.85	21.75				
AE-15	Air Entry Well	1254399.5	537740.45	2533	2.11	26.48				
AE-16	Air Entry Well	1254426.5	537764.44	2535	2.05	31.53		Blocked @ 1.03 ft btoc		
AE-17	Air Entry Well	1254144.3	537688.02	2507	1.8	17.3		Blocked @ 11.69 ft btoc		
AE-18	Air Entry Well	1254174.9	537670.15	2513	1.8	16.75				
AE-19	Air Entry Well	1254205.8	537689.59	2510	1.95	12.89				
AE-20	Air Entry Well	1254236.9	537677.07	2519	1.92	23.75				
AE-21	Air Entry Well	1254267.8	537696	2520	2.28	24.5				
AE-22	Air Entry Well	1254305.4	537678.21	2527	2.08	26.1				
AE-23	Air Entry Well	1254335	537702.81	2528	1.87	27.15				
AE-24	Air Entry Well	1254368.3	537681.45	2535	2.19	21.7				
AE-25	Air Entry Well	1254400.4	537705.28	2538	2.13	24.75				
AE-26	Air Entry Well	1254242.9	537637.43	2525	1.88	27.02				
AE-27	Air Entry Well	1254276.4	537629.12	2530	1.9	21.75				
AE-28	Air Entry Well	1254306.3	537643.28	2532	1.63	20.23				
AE-29	Air Entry Well	1254339.7	537628.69	2537	2	21.65				
AE-30	Air Entry Well	1254370.1	537649.42	2540	1.9	21.51				
HP-01	ISCO Injection Well	1254363.2	537865.22	2514	1.3	20.45				
HP-02	ISCO Injection Well	1254346.9	537806.95	2517	1.4	25.5		Blocked @ 19.28 ft btoc		
HP-03	ISCO Injection Well	1254227.2	537765.45	2497	1.2	15.4				
HP-04	ISCO Injection Well	1254433.9	537783.79	2535	1.85	30.9				
HP-05a	ISCO Injection Well	1253977.8	537721.79	2483	1.1	7.3		TD=5.03 ft btoc		
HP-05b	ISCO Injection Well	1254370.4	537917.83	2494	0	4.4		Underwater		
HP-05c	ISCO Injection Well	1254401.5	537958.62	2494	1.1	3.23		Underwater		
HP-05d	ISCO Injection Well	1254417.9	537988.55	2494	1.1	--		Underwater		
HP-06	ISCO Injection Well	1254142.4	537729.11	2495	0.9	15.5				
HP-07	ISCO Injection Well	1254275.9	537743.69	2510	1.9	20.65				
HP-08	ISCO Injection Well	1254379.4	537752.06	2529	1.45	24.05				
HP-09	ISCO Injection Well	1254200.5	537711.54	2505	1.95	25.5				
HP-10	ISCO Injection Well	1254288.4	537687.92	2524	1.45	25.43				

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Table 6-2. Ongoing NAPL gauging and recovery locations, DQOs and monitoring frequency with NAPL thickness trends shown on sparklines.

Location Name	Location Type[1]	Easting[2]	Northing[2]	Ground Elevation (ft amsl)	Stickup (ft)	Total Depth (ft btoc)	NAPL Thickness Trends	Well Status 9/2024	DQO	Frequency
V-01	Turbine Vent Well	1254293.2	537827.37	2497	4.58	18.5			Measure for and Recover NAPL	Gage and Recover at a minimum 2 times during a field season
V-02	Turbine Vent Well	1254358.9	537832.5	2516	3.95	23.1				
V-03	Turbine Vent Well	1254191	537766.39	2495	4.28	18.6				
V-04	Turbine Vent Well	1254262.9	537771.64	2500	4.28	18.1				
V-05	Turbine Vent Well	1254328.1	537776.54	2516	4.57	28.1		Blocked @ 7.75 ft btoc		
V-06	Turbine Vent Well	1254393.6	537782.17	2528	4.39	28.31				
V-08	Turbine Vent Well	1254168.5	537711.39	2502	4.65	28.19				
V-09	Turbine Vent Well	1254232.2	537712.98	2510	4.5	26.5				
V-10	Turbine Vent Well	1254297.1	537717.68	2521	4.51	20.35				
V-11	Turbine Vent Well	1254366.8	537720.04	2530	4.08	33.1				
V-12	Turbine Vent Well	1254207.9	537652.3	2520	4.18	27.95				
V-13	Turbine Vent Well	1254269.4	537660.85	2525	4.66	28.23				
V-14	Turbine Vent Well	1254336.2	537663.07	2533	4.58	30.29				
B-103(P)	Monitoring Well	1254170	537517	2542	3.6	45.6				
B-106(P)	Monitoring Well	1254386	537586	2549	3.5	28.5				
B-108(P)	Monitoring Well	1254624	537822	2565	3.5	43.5				

amsl = above mean sea level

bbls = barrels

btoc = below top of collar

ft = feet

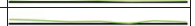
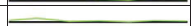
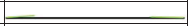
[1]Location Type determines construction of the well. AE wells have a 1 inch casing diameter, V wells have a 2 inch casing diameter, HP wells have a 2 inch casing diameter. HP-05a-d have 1 inch casing diameter. Monitoring wells have a 2 inch diameter.

[2]Eastings and Northings are in feet relative to the North American Datum of 1983 (NAD 83). EPSG: 2266.

The sparklines show the temporal thickness in each bore from 2017 through 2024 (—) compared to zero LNAPL (---).

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Table 6-3. Specified ongoing CO_2 efflux monitoring locations, DQOs and frequency with CO_2 efflux trends shown on sparklines.

Location	Type	Easting	Northing	CO_2 Efflux Trends	Method	DQO	Frequency
I-01	Impacted	1254142.933	537737.2916		LI-COR Biosciences dynamic closed chamber	Confirm ongoing biodegredation and NSZD	Once a field season
I-02		1254198.685	537751.8294				
I-03		1254231.425	537782.2335				
I-04		1254265.028	537799.7002				
I-05		1254287.8	537841.3263				
I-06		1254167.404	537690.6888				
I-07		1254197.735	537700.9473				
I-08		1254269.529	537746.3371				
I-09		1254307.713	537768.1079				
I-10		1254333.241	537792.4867				
I-11		1254370.157	537847.7614				
I-12		1254186.126	537662.3506				
I-13		1254246.733	537688.7408				
I-14		1254287.88	537703.6062				
I-15		1254304.017	537731.0133				
I-16		1254324.054	537718.7746				
I-17		1254339.96	537752.6894				
I-18		1254370.749	537787.9668				
I-19		1254399.16	537807.6579				
I-20		1254219.053	537647.4148				
I-21		1254283.51	537650.6547				
I-22		1254333.844	537680.1661				
I-23		1254361.256	537703.2019				
I-24		1254450.619	537797.7276				
I-25		1254207.356	537767.4411				
I-26		1254281.021	537847.4552				
I-27		1254333.786	537644.81				
I-28		1254407.541	537754.025				
U-01	Unimpacted	1254262.666	537468.9642				
U-02		1254358.644	537499.6478				
U-03		1254423.538	537575.0059				
U-04		1254476.186	537660.2659				
U-05		1254537.716	537740.8241				
U-06		1254475.58	537469.5747				
U-07		1254226.073	537558.8983				
U-08		1254291.133	537569.7012				
U-09		1254312.807	537479.4532				
U-10		1254398.796	537529.6726				
U-11		1254452.262	537616.669				
U-12		1254502.16	537700.9072				

All units mg/L.

NA = Sample not taken.

U = Non-detect. The detection limit is shown for samples that were non-detect for the constituent listed.

The sparklines show zero (---) and the temporal variability (---) from 2018 to 2024.

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Table 6-4. Proposed borehole locations and analytical regimen for the Lowland Investigation Area.

Proposed Location	Location Type	Easting[1]	Northing[1]	GSE (ft amsl)	Anticipated Clay Elevation (ft amsl)	Anticipated Clay Depth (ft bgs)	Field Screening	Lab Sampling
Boring 1	Direct Push Boring	1254075.677	537731.3606	2484.5	2475.5	9.0	PID	Composite of each core run (2.5 ft) for TPH by MADEP VPH and EPH
Boring 2	Direct Push Boring	1254083.223	537717.3632	2485.7	2477.1	8.6		
Boring 3	Direct Push Boring	1254091.436	537702.3923	2489.3	2480.0	9.3		
Boring 4	Direct Push Boring	1254101.916	537745.9049	2484.8	2473.5	11.3		
Boring 5	Direct Push Boring	1254109.461	537731.9075	2485.7	2474.2	11.6		
Boring 6	Direct Push Boring	1254129.141	537726.4058	2489.1	2477.6	11.5		
Boring 7	Direct Push Boring	1254128.154	537760.4491	2485.2	2473.2	12.0		
Boring 8	Direct Push Boring	1254135.7	537746.4518	2489.1	2473.8	15.3		
Boring 9	Direct Push Boring	1254143.913	537731.4808	2491.1	2476.5	14.6		
Boring 10	Direct Push Boring	1254154.393	537774.9934	2485.7	2476.1	9.6		
Boring 11	Direct Push Boring	1254150.196	537758.3697	2491.1	2477.8	13.3		
Boring 12	Direct Push Boring	1254170.151	537746.025	2494.6	2478.7	15.9		
Boring 13	Direct Push Boring	1254180.631	537789.5377	2487.0	2475.9	11.2		
Boring 14	Direct Push Boring	1254188.177	537775.5403	2492.2	2475.8	16.4		
Boring 15	Direct Push Boring	1254206.87	537804.0819	2489.0	2478.3	10.7		
Boring 16	Direct Push Boring	1254214.416	537790.0845	2489.9	2478.6	11.3		
Boring 17	Direct Push Boring	1254233.108	537818.6262	2490.5	2482.9	7.6		
Boring 18	Direct Push Boring	1254240.654	537804.6288	2490.4	2484.0	6.5		
Boring 19	Direct Push Boring	1254248.867	537789.6578	2493.4	2485.7	7.7		
Boring 20	Direct Push Boring	1254259.347	537833.1704	2492.3	2485.6	6.7		
Boring 21	Direct Push Boring	1254266.893	537819.1731	2493.3	2486.3	6.9		
Boring 22	Direct Push Boring	1254285.586	537847.7147	2494.9	2487.8	7.1		

[1]Eastings and Northings are in feet relative to the North American Datum of 1983 (NAD 83). EPSG: 2266.
amsl = above mean sea level
bgs = below ground surface
GSE = ground surface elevation (ft amsl) based on recent survey data
PID = photoionization detector

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Table 6-5. Surficial contamination dataset (samples intersecting or shallower than 3 ft bgs).

Location	Location Type	Analysis Type	Sample Date	Depth From (ft bgs)	Depth To (ft bgs)	Depth Midpoint	ppmv	Top 3ft Value	Superceded By	Easting[1]	Northing[1]	Classification
DP-2023-01	Borehole	PID	9/26/2023	0	2.5	1.25	0	0	DP-2023-01-2.5	1254332.092	537672.5918	Superceded
				2.5	5	3.75	1600					
DP-2023-02	Borehole	PID	9/26/2023	0	4.5	2.25	0	0	-	1254272.091	537654.2637	Unimpacted
DP-2023-03	Borehole	PID	9/26/2023	0	2.5	1.25	0	0	-	1254205.058	537621.1678	Unimpacted
				2.5	5	3.75	0					
DP-2023-04	Borehole	PID	9/26/2023	0	2.5	1.25	4.2	4.2	-	1254236.614	537667.733	Unimpacted
				2.5	5	3.75	802					
DP-2023-05	Borehole	PID	9/26/2023	0	3	1.5	0	0	-	1254294.997	537691.1598	Unimpacted
DP-2023-06	Borehole	PID	9/27/2023	0	9	4.5	0	0	-	1254372.267	537735.2897	Unimpacted
DP-2023-07	Borehole	PID	9/27/2023	0	3	1.5	0	0	-	1254438.247	537779.7887	Unimpacted
DP-2023-08	Borehole	PID	9/27/2023	0	4	2	0	0	-	1254388.204	537774.8376	Unimpacted
DP-2023-09	Borehole	PID	9/27/2023	0	4	2	508.8	508.8	-	1254317.404	537736.8701	Impacted
DP-2023-10	Borehole	PID	9/27/2023	0	4	2	0	0	-	1254283.252	537715.8673	Unimpacted
DP-2023-11	Borehole	PID	9/27/2023	0	4	2	0	0	-	1254237.381	537710.2591	Unimpacted
DP-2023-12	Borehole	PID	9/27/2023	0	3.5	1.75	0	0	-	1254185.631	537673.291	Unimpacted
DP-2023-13	Borehole	PID	9/27/2023	0	4	2	0	0	-	1254182.455	537725.5654	Unimpacted
DP-2023-14	Borehole	PID	9/29/2023	0	3.5	1.75	0	0	-	1254143.782	537720.5757	Unimpacted
DP-2023-15	Borehole	PID	9/28/2023	0	3	1.5	0	0	-	1254257.445	537737.1788	Unimpacted
DP-2023-16	Borehole	PID	9/28/2023	0	3	1.5	0.4	0.4	-	1254269.962	537755.5558	Unimpacted
DP-2023-17	Borehole	PID	9/28/2023	0	3.5	1.75	0.2	0.2	-	1254335.423	537799.8382	Unimpacted
DP-2023-18	Borehole	PID	9/28/2023	0	3.5	1.75	0.7	0.7	-	1254391.569	537839.032	Unimpacted
DP-2023-19	Borehole	PID	9/28/2023	0	3.5	1.75	0	0	-	1254372.111	537861.885	Unimpacted
DP-2023-20	Borehole	PID	9/28/2023	0	3.5	1.75	920.3	920.3	-	1254291.87	537829.3671	Impacted
DP-2023-21	Borehole	PID	9/28/2023	0	5	2.5	0	0	-	1254256.673	537764.5953	Unimpacted
DP-2023-22	Borehole	PID	9/28/2023	0	4	2	0	0	-	1254219.893	537761.2685	Unimpacted
DP-2023-23	Borehole	PID	9/29/2023	0	3	1.5	0	0	-	1254152.704	537759.4452	Unimpacted
DP-2023-24	Borehole	PID	9/29/2023	0	3	1.5	343	343	-	1254131.649	537727.4813	Impacted
DP-2023-25	Borehole	PID	9/28/2023	0	3	1.5	0	0	-	1254289.571	537793.0095	Unimpacted
DP-2023-26	Borehole	PID	9/28/2023	0	3.5	1.75	88.1	88.1	-	1254337.087	537770.3162	Impacted
DP-1	Borehole	PID	8/21/2017	0	1.2	0.6	0	0.25	-	1254353.808	537631.6962	Unimpacted
				1.2	3.5	2.35	0.5					
DP-2	Borehole	PID	8/21/2017	0	2	1	347	585	-	1254313.302	537695.5644	Impacted
				2	3.5	2.75	823					
DP-3	Borehole	PID	8/21/2017	0	2.5	1.25	522	522	DP-2023-16	1254268.698	537755.7402	Superceded
				2.5	5	3.75	594					
DP-4	Borehole	PID	8/21/2017	0	2.5	1.25	1	1	-	1254292.163	537589.1338	Unimpacted
				2.5	5.5	4	1					
DP-5	Borehole	PID	8/21/2017	0	2	1	0.8	214.4	-	1254248.63	537652.4922	Impacted
				2	5	3.5	428					
DP-6	Borehole	PID	8/21/2017	0	2	1	309	156.7	-	1254206.836	537713.851	Impacted
				2	4.5	3.25	4.4					

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Table 6-5. Surficial contamination dataset (samples intersecting or shallower than 3 ft bgs).

Location	Location Type	Analysis Type	Sample Date	Depth From (ft bgs)	Depth To (ft bgs)	Depth Midpoint	ppmv	Top 3ft Value	Superceded By	Easting[1]	Northing[1]	Classification
DP-7	Borehole	PID	8/22/2017	0	2.5	1.25	517.6	517.6	-	1254148.103	537669.9381	Impacted
				2.5	5	3.75	99.3					
DP-8	Borehole	PID	8/22/2017	0	2.5	1.25	2.7	2.7	-	1254188.127	537608.566	Unimpacted
				2.5	5	3.75	0.9					
DP-9	Borehole	PID	8/22/2017	0	2	1	1.4	1.95	-	1254415.269	537674.4959	Unimpacted
				2	4	3	2.5					
DP-10	Borehole	PID	8/22/2017	0	2	1	343	216.05	-	1254373.413	537736.131	Impacted
				2	4.5	3.25	89.1					
DP-11	Borehole	PID	8/22/2017	0	2	1	96.3	51.15	DP-2023-17	1254333.359	537800.4004	Superceded
				2	4.5	3.25	6					
DP-12	Borehole	PID	8/22/2017	0	2	1	37.9	22.8	DP-2023-18	1254392.696	537838.7667	Superceded
				2	5	3.5	7.7					
DP-13	Borehole	PID	8/22/2017	0	2	1	7.9	6.2	-	1254436.135	537779.8772	Unimpacted
				2	4.5	3.25	4.5					
DP-17	Borehole	PID	8/23/2017	0	2.5	1.25	0.6	0.6	-	1254219.387	537847.23	Unimpacted
				2.5	5	3.75	0.9					
DP-18	Borehole	PID	8/23/2017	0	3	1.5	1.1	1.1	-	1254104.648	537777.0323	Unimpacted
AE-01	Air Entry Well	PID	10/17/2017	0	1	0.5	0	0	-	1254325.24	537849.7969	Unimpacted
				1	2.5	1.75	0	0	-			
				2.5	3	2.75	0	0	-			
AE-03	Air Entry Well	PID	10/19/2017	0	2.5	1.25	0	0	-	1254326.864	537815.4753	Unimpacted
				2.5	5	3.75	0					
AE-05	Air Entry Well	PID	10/19/2017	0	2.5	1.25	5.1	5.1	-	1254297.943	537790.3692	Unimpacted
				2.5	5	3.75	7.5					
AE-06	Air Entry Well	PID	10/19/2017	0	2.5	1.25	0	0	-	1254359.474	537801.2931	Unimpacted
AE-09	Air Entry Well	PID	10/20/2017	0	2.5	1.25	0	0	-	1254165.087	537746.6977	Unimpacted
				2.5	5	3.75	0					
AE-12	Air Entry Well	PID	10/18/2017	0	2.5	1.25	0	0	-	1254296.818	537753.3	Unimpacted
	Air Entry Well	PID		2.5	5	3.75	7.1					
AE-19	Air Entry Well	PID	10/23/2017	0	5	2.5	3.3	3.3	-	1254205.839	537689.5862	Unimpacted
AE-26	Air Entry Well	PID	10/23/2017	0	5	2.5	5.9	5.9	-	1254242.939	537637.4305	Unimpacted
HP-01	ISCO Injection Well	PID	10/17/2017	0	2.5	1.25	0	0	-	1254363.165	537865.2223	Unimpacted
				2.5	5	3.75	0					
HP-02	ISCO Injection Well	PID	10/17/2017	0	2.5	1.25	0	0	-	1254346.911	537806.9515	Unimpacted
				2.5	5	3.75	0					
HP-03	ISCO Injection Well	PID	10/18/2017	0	2.5	1.25	0	0	-	1254227.224	537765.4488	Unimpacted
				2.5	5	3.75	0					
HP-04	ISCO Injection Well	PID	10/18/2017	0	2.5	1.25	0	0	-	1254433.869	537783.7937	Unimpacted
				2.5	5	3.75	0					
HP-06	ISCO Injection Well	PID	10/18/2017	0	2.5	1.25	8	8	-	1254142.396	537729.1122	Impacted
				2.5	5	3.75	7.1					

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Table 6-5. Surficial contamination dataset (samples intersecting or shallower than 3 ft bgs).

Location	Location Type	Analysis Type	Sample Date	Depth From (ft bgs)	Depth To (ft bgs)	Depth Midpoint	ppmv	Top 3ft Value	Superceded By	Easting[1]	Northing[1]	Classification
HP-07	ISCO Injection Well	PID	10/21/2017	0	2.5	1.25	0		-	1254275.853	537743.6875	Unimpacted
				2.5	5	3.75	0	0				
HP-08	ISCO Injection Well	PID	10/21/2017	0	2.5	1.25	0		-	1254379.371	537752.0648	Unimpacted
				2.5	5	3.75	0	0				
HP-09	ISCO Injection Well	PID	10/20/2017	0	2.5	1.25	0		-	1254200.527	537711.5379	Unimpacted
				2.5	5	3.75	0	0				
HP-10	ISCO Injection Well	PID	10/21/2017	0	2.5	1.25	0		-	1254288.351	537687.9163	Unimpacted
				2.5	5	3.75	0	0				
V-01	Turbine Vent Well	PID	10/19/2017	0	2.5	1.25	6		-	1254293.218	537827.3702	Unimpacted
				2.5	5	3.75	101	6				
V-02	Turbine Vent Well	PID	10/19/2017	0	2.5	1.25	0		-	1254358.859	537832.5001	Unimpacted
				2.5	5	3.75	0	0				
V-04	Turbine Vent Well	PID	10/18/2017	0	2.5	1.25	0		-	1254262.86	537771.6417	Unimpacted
				2.5	5	3.75	0	0				
V-05	Turbine Vent Well	PID	10/19/2017	0	2.5	1.25	0		-	1254328.134	537776.5364	Unimpacted
				2.5	5	3.75	0	0				
V-08	Turbine Vent Well	PID	10/20/2017	0	2.5	1.25	0		-	1254168.458	537711.385	Unimpacted
				2.5	5	3.75	0	0				
V-09	Turbine Vent Well	PID	10/20/2017	0	2.5	1.25	0		-	1254232.245	537712.983	Unimpacted
				2.5	5	3.75	0	0				
V-11	Turbine Vent Well	PID	10/22/2017	0	2.5	1.25	0		-	1254366.808	537720.0405	Unimpacted
				2.5	5	3.75	0	0				
V-14	Turbine Vent Well	PID	10/22/2017	0	2.5	1.25	0		-	1254336.231	537663.0723	Unimpacted
				2.5	5	3.75	0	0				
SB-02	Borehole	UVOST	8/28/2019	2.5	3	2.75	25%	25%	DP-2023-01-2.5	1254329.968	537671.9604	Superceded
SB-06	Borehole	UVOST	8/28/2019	0	0.5	0.25	47%	47%	DP-2023-02	1254271.167	537654.1754	Superceded
SB-21	Borehole	UVOST	8/28/2019	0	0.5	0.25	42%	29%	DP-2023-04	1254237.244	537669.3568	Superceded
			8/28/2019	0.5	1	0.75	26%					
			8/28/2019	1	1.5	1.25	25%					
			8/28/2019	1.5	2	1.75	26%					
			8/28/2019	2	2.5	2.25	27%					
			8/28/2019	2.5	3	2.75	29%					
SB-33	Borehole	UVOST	8/28/2019	0	0.5	0.25	36%	36%	-	1254239.12	537752.7292	Impacted
DP-2023-01-2.5	Borehole	TPH Lab Analysis	9/26/2023	2.5	2.5	2.5	9060	9060 mg/kg	-	1254332.092	537672.5918	Impacted

PID = Photo Ionization Detector, UVOST = Ultra Violet Optical Screening Tool, TPH = total petroleum hydrocarbon (Diesel plus Gas range organics)

[1]Eastings and Northings are in feet relative to the North American Datum of 1983 (NAD 83). EPSG: 2266

Air Entry, ISCO Injection, and Turbine Vent well top and bottom PID depths are estimated from handwritten field logs.

UVOST detects the presence or absence of NAPL. UVOST < 25% cannot be used to identify unimpacted soil, however UVOST >25% is indicative of impacted soils

Samples from 2.5 to 5 ft bgs (denoted as red and underlined when impacted) are not representative of the top 3 ft.

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Table 6-6. Proposed surficial soil investigation in the Upland area.

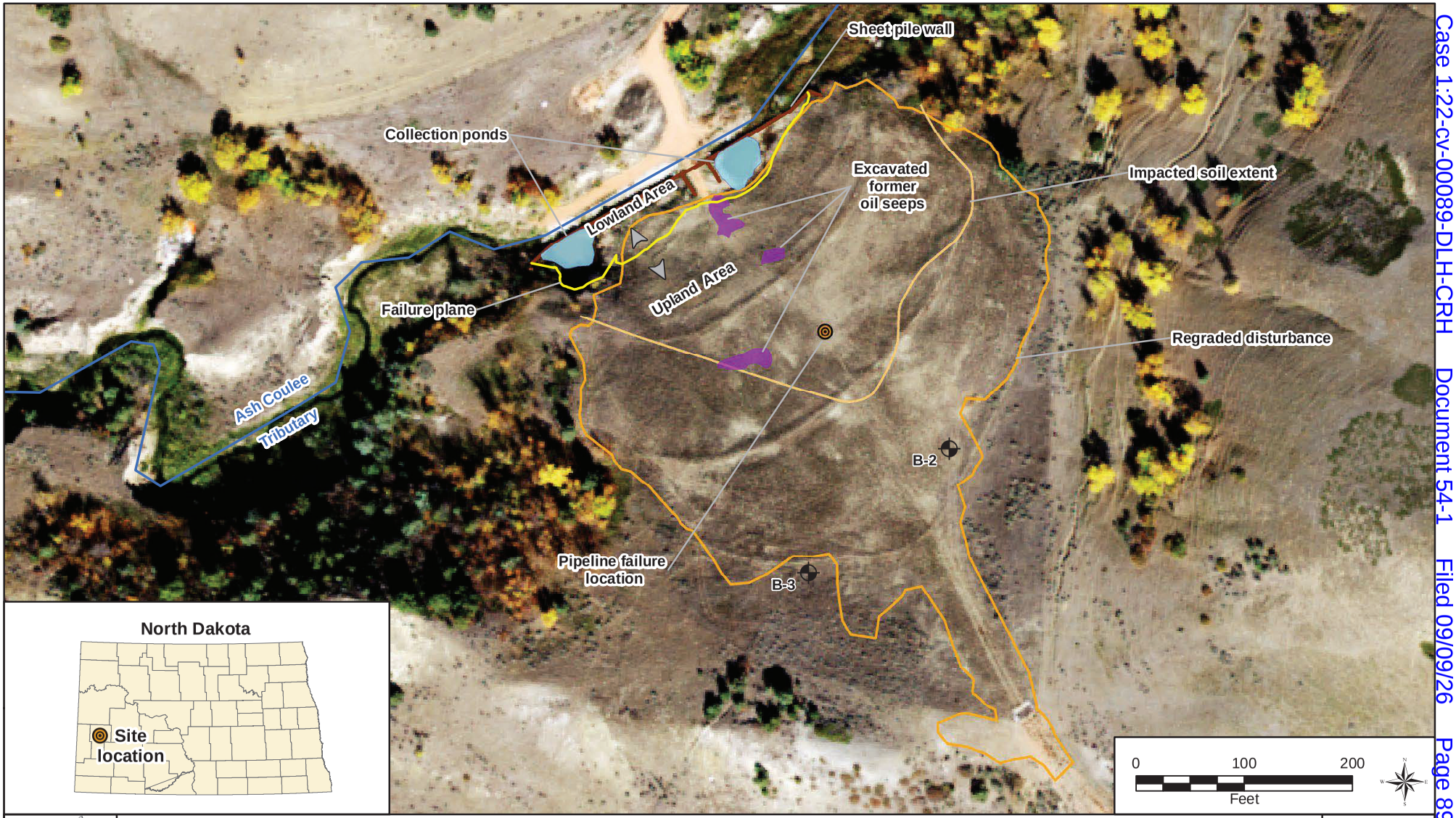
Proposed Location	Prior Borehole Source	Location Type	Easting[1]	Northing[1]	GSE (ft amsl)	Field Screening	Grab sample
S-32	DP-10	Direct Push	1254380.904	537735.06	2532.6	PID	3 ft composite of soil for TPH by MADEP VPH and EPH
S-33	DP-10		1254390.904	537735.06	2534.2		
S-34	DP-10		1254370.904	537725.06	2532.2		
S-35	DP-10		1254370.904	537715.06	2533.4		
S-36	DP-10		1254360.904	537735.06	2529.4		
S-37	DP-10		1254350.904	537735.06	2527.9		
S-38	DP-10		1254370.904	537745.06	2529.7		
S-39	DP-10		1254370.904	537755.06	2528.8		
S-77	DP-10		1254370.904	537735.06	2531.0		
S-56	DP-2		1254318.94	537692.64	2528.0		
S-58	DP-2		1254308.94	537682.64	2528.0		
S-59	DP-2		1254298.94	537692.64	2525.8		
S-60	DP-2		1254288.94	537692.64	2524.6		
S-61	DP-2		1254308.94	537702.64	2525.5		
S-62	DP-2		1254308.94	537712.64	2524.1		
S-81	DP-2		1254308.941	537692.64	2526.7		
S-6	DP-2 and DP-2023-01		1254309.583	537671.52	2529.4		
S-57	DP-2 and DP-2023-01		1254328.94	537692.64	2529.3		
S-1	DP-2023-01		1254339.583	537671.52	2533.4		
S-2	DP-2023-01		1254349.583	537671.52	2534.9		
S-3	DP-2023-01		1254329.583	537661.52	2533.0		
S-4	DP-2023-01		1254329.583	537651.52	2534.1		
S-5	DP-2023-01		1254319.583	537671.52	2530.6		
S-7	DP-2023-01		1254329.583	537681.52	2530.8		
S-82	DP-2023-01		1254329.583	537671.52	2531.8		
S-40	DP-2023-09		1254324.895	537735.79	2523.5		
S-41	DP-2023-09		1254334.895	537735.79	2525.3		
S-42	DP-2023-09		1254314.895	537725.79	2523.2		
S-43	DP-2023-09		1254314.895	537715.79	2524.7		
S-44	DP-2023-09		1254304.895	537735.79	2520.4		
S-45	DP-2023-09		1254294.895	537735.79	2518.1		
S-46	DP-2023-09		1254314.895	537745.79	2520.6		
S-47	DP-2023-09		1254314.895	537755.79	2518.8		
S-78	DP-2023-09		1254314.895	537735.79	2521.9		
S-63	DP-2023-20		1254299.361	537828.29	2502.3		
S-64	DP-2023-20		1254309.361	537828.29	2506.0		
S-65	DP-2023-20		1254289.361	537818.29	2500.9		
S-66	DP-2023-20		1254289.361	537808.29	2503.4		
S-75	DP-2023-20		1254289.362	537828.29	2498.6		
S-8	DP-2023-26		1254344.578	537769.24	2522.9		
S-9	DP-2023-26		1254354.578	537769.24	2525.0		
S-10	DP-2023-26		1254334.578	537759.24	2522.3		
S-11	DP-2023-26		1254334.578	537749.24	2523.6		
S-12	DP-2023-26		1254324.578	537769.24	2518.6		
S-13	DP-2023-26		1254314.578	537769.24	2515.9		
S-14	DP-2023-26		1254334.578	537779.24	2519.6		
S-15	DP-2023-26		1254334.578	537789.24	2518.4		
S-76	DP-2023-26		1254334.578	537769.24	2520.9		
S-24	DP-5		1254256.121	537651.42	2526.0		
S-25	DP-5		1254266.121	537651.42	2527.1		
S-26	DP-5		1254246.121	537641.42	2526.2		
S-27	DP-5		1254246.121	537631.42	2527.7		
S-28	DP-5		1254236.122	537651.42	2523.8		
S-29	DP-5		1254226.122	537651.42	2522.8		
S-30	DP-5		1254246.121	537661.42	2523.4		
S-31	DP-5		1254246.121	537671.42	2522.0		
S-83	DP-5		1254246.121	537651.42	2524.9		
S-16	DP-6		1254214.328	537712.78	2508.2		
S-17	DP-6		1254224.328	537712.78	2509.5		
S-18	DP-6		1254204.328	537702.78	2509.3		
S-19	DP-6		1254204.328	537692.78	2512.2		
S-20	DP-6		1254194.328	537712.78	2504.9		
S-21	DP-6		1254184.328	537712.78	2504.3		
S-22	DP-6		1254204.328	537722.78	2503.4		
S-23	DP-6		1254204.328	537732.78	2501.3		
S-80	DP-6		1254204.328	537712.78	2506.1		
S-48	DP-7		1254155.595	537668.86	2513.5		
S-49	DP-7		1254165.595	537668.86	2513.7		
S-50	DP-7		1254145.595	537658.86	2516.0		
S-51	DP-7		1254145.595	537648.86	2518.3		
S-52	DP-7		1254135.595	537668.86	2513.8		
S-53	DP-7		1254125.595	537668.86	2514.0		
S-54	DP-7		1254145.595	537678.86	2510.5		
S-55	DP-7		1254145.595	537688.86	2509.3		
S-84	DP-7		1254145.595	537668.86	2513.3		
S-67	SB-33_UVOST		1254246.612	537751.65	2504.2		
S-68	SB-33_UVOST		1254256.612	537751.65	2505.9		
S-69	SB-33_UVOST		1254236.612	537741.65	2504.7		
S-70	SB-33_UVOST		1254236.612	537731.65	2507.3		
S-71	SB-33_UVOST		1254226.612	537751.65	2500.7		
S-72	SB-33_UVOST		1254216.612	537751.65	2498.7		
S-73	SB-33_UVOST		1254236.612	537761.65	2499.7		
S-74	SB-33_UVOST		1254236.612	537771.65	2497.3		
S-79	SB-33_UVOST		1254236.612	537751.65	2502.4		

[1]Eastings and Northings are in feet relative to the North American Datum of 1983 (NAD 83). EPSG: 2266.

GSE = ground surface elevation (ft amsl) based on recent survey data

PID = photoionization detector

Figures



GEOMEGA
3/3/25
C24-1207
True Oil

The Ash Coulee site showing major remedial features and the location of the pipeline failure on a 2021 aerial photograph.
B-2 and B-3 were exploratory boreholes designed to characterize site geology. The Upland Area extends from the failure plane to the impacted soil extent.

Figure
1-1

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AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **37-03373** LOG OF BORING NO. **B-2 (p. 1 of 2)**

PROJECT: **Ash Coulee Slope Failure; Belfield, ND**

DEPTH IN FEET	MATERIAL DESCRIPTION (SURFACE ELEVATION: 2557.9)	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS MC	DEN	LL	PL	%-200
1	**CLAYEY SAND** with organics, dark brown (SC)	TOPSOIL	6	M	SS	24					
2	**CLAYEY SAND**, brown, firm to stiff (SC)	SLOPEWASH									
6	**FAT CLAY** with laminations of gypsum, gray, stiff (CH)		12	M	SS	12	27		63	25	100
10	**FAT CLAY** with trace lignite, tan with iron oxide stains, firm (CH)		8	M	SS	12					
15	**LEAN CLAY**, tan with iron oxide stains, stiff (CL)		15	M	SS	16	24				99
20			11	M	SS	12					
26	**LEAN CLAY** with laminations of sand and lignite, gray, stiff (CL)		15	M	SS	12	22		31	22	93
30	**LIGNITE**, black	SENTINEL BUTTE FORMATION	12	W	SS	10					
32	**FAT CLAY**, gray, stiff to very stiff (CH)		14	M	SS	12	24				90
34											

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-60' 3.25" HSA	**5/18/17**	**15:00**	**61.5**	**0.0**	**48.0**	**NA**	**33.7**
	5/18/17	**16:00**	**61.5**	**0.0**	**NA**	**NA**	**33.0**
BORING COMPLETED: **5/18/17**	**5/19/17**	**11:00**	**61.5**	**0.0**	**NA**	**NA**	**33.6**
DR: **CK** LG: **TE** Rig: **14**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 37-03373.GPJ AET+CPT+WELL.GDT 6/1/17

03/2011 01-DHR-060

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **37-03373** LOG OF BORING NO. **B-3 (p. 2 of 2)**

PROJECT: **Ash Coulee Slope Failure; Belfield, ND**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS MC	DEN	LL	PL	%-200
36	**FAT CLAY**, dark gray, stiff to hard (CH) *(continued)*	SENTINEL BUTTE FORMATION *(continued)*	29	M	SS						
39	**LIGNITE**, black										
41			50/.4	M	SS	12					
42	**FAT CLAY**, dark gray, hard (CH)		72/.9	W	SS	14					
43	**LIGNITE**, black										
46	**FAT CLAY**, gray, hard to very stiff (CH)		31	M	SS	14	27		81	28	99
51			27	M	SS	16					
	Bottom of Boring										

AET_CORP 37-03373.GPJ AET+CPT+WELL.GDT 6/1/17

03/2011 01-DHR-060

GEOMEGA

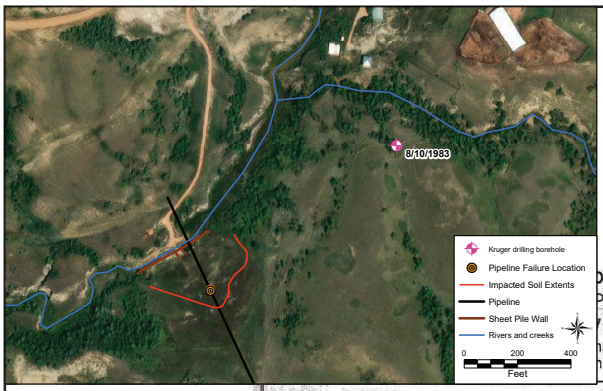
2/4/25

C241207
True Oil

Bore logs B2 and B3 located on the Ash Coulee site (Figure 1-1) showing the underlying Sentinel Butte clay containing thin coal seams.

Figure
1-2

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STATE OF NORTH DAKOTA
OF WATER WELL CONTRACTORS
OULEVARD • BISMARCK, NORTH DAKOTA 58501

ELL DRILLER'S REPORT

hat this report be filed with the State Board of Water Well
n 30 days after completion or abandonment of the well.

1. WELL OWNER
Name Ed Egly
Address Belfield N Dak

2. WELL LOCATION
Sketch map location must agree with written location.
NORTH
1 Mile
County Billings
¼ ¼ NW¼ Sec. 21 Twp. 142 N. Rg. 104 W.

3. PROPOSED USE
☐ Domestic ☐ Irrigation ☐ Industrial
☒ Stock ☐ Municipal ☐ Test Hole

4. METHOD DRILLED
☐ Cable ☐ Reverse Rotary ☐ Bored
☒ Forward Rotary ☐ Jetted ☐ Other
If other, specify

5. WATER QUALITY
Was a water sample collected for chemical analysis?
☐ Yes ☒ No
If so, to what laboratory was it sent

6. WELL CONSTRUCTION
Diameter of hole 7⅞ inches. Depth 1630 feet.
Casing: ☒ Steel ☐ Plastic ☐ Concrete
☒ Threaded ☐ Welded ☐ Other
If other, specify

Pipe Weight:	Diameter:	From:	To:
16 lb/ft.	5 inches	0 feet	1560 feet
lb/ft.	2 inches	1503 feet	1735 feet
lb/ft.	inches	feet	feet
lb/ft.	inches	feet	feet

Was perforated pipe used? ☐ Yes ☒ No
Length of pipe perforated feet
Was casing left open end? ☒ Yes ☐ No
Was a well screened installed? ☐ Yes ☒ No
Material Pvc pipe 3" Diameter 2" inches
(stainless steel, bronze, etc.)
Slot size Tomch set from 1622 feet to 1735 feet
Slot size set from feet to feet
Slot size set from feet to feet
Slot size set from feet to feet
Was a packer or seal used? ☒ Yes ☐ No
If so, what material K-Packers
Type of well: Straight screen ☐ Gravel packed ☐
Was the well grouted? Yes ☒ No ☐
To what depth? 0-1560 feet
Material used in grouting Cmt
Well head completion: Pitless adapter x
12" above grade x Other
If other, specify
Was well disinfected upon completion? ☒ Yes ☐ No

7. WATER LEVEL
Static water level 220 feet below land surface
If flowing: closed-in pressure psi
GPM flow through inch pipe
Controlled by: ☐ Valve ☐ Reducers ☐ Other
If other, specify

8. WELL TEST DATA
☐ Pump ☐ Bailer ☒ Other
Pumping level below land surface:
380 ft. after 2 hrs. pumping 35 gpm
ft. after hrs. pumping gpm
ft. after hrs. pumping gpm

9. WELL LOG

Formation	Depth (ft.) From	To
Clay + Sol Dry	0	180
Clay	180	415
Coal	415	435
225 gpm with" Sand fine	435	455
clay	455	550
Coal	550	620
clay	620	735
Must be Dry" Sand	735	785
Clay	785	860
Sand	860	910
clay	910	1150
Coal	1150	1195
clay	1195	1220
Coal	1220	1255
clay	1255	1540
Rock	1540	1602
Must be Dry" Sand	1543	1630
Shale	1630	1665
Sand	1665	1730
Shale	1730	1735

(Use separate sheet if necessary.)

10. DATE COMPLETED 8-10-83

11. WAS WELL PLUGGED OR ABANDONED?
☐ Yes ☒ No
If so, how

12. REMARKS:

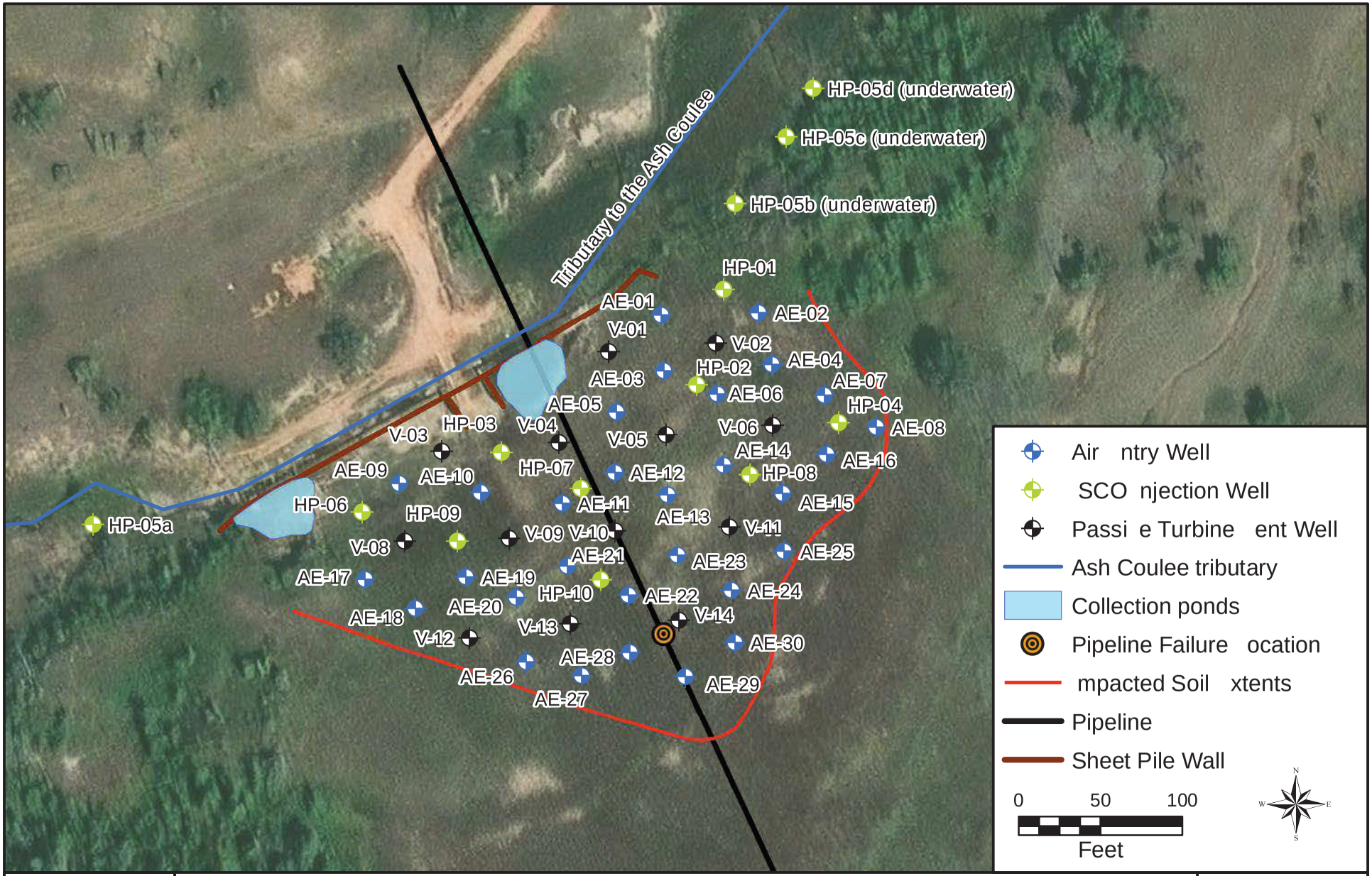
13. DRILLER'S CERTIFICATION
This well was drilled under my jurisdiction and this report is true to the best of my knowledge.
Kruger Drilling # 34
Driller's or Firm's Name Certificate No.
Rt 1 Box 23
Address Belfield N Dak 10-2-83
Signed by Don Kruger Date

WHITE—DRILLER'S COPY YELLOW—BOARD'S COPY PINK—CUSTOMER'S COPY

GEOMEGA
1/17/25
C241207
True Oil

A bore adjacent to the Ash Coulee Site demonstrates that the clay layer is continuous for ~1,000 feet below ground surface with only a thin 10 ft interval at 425 ft bgs.

Figure
1-3



GEOMEGA

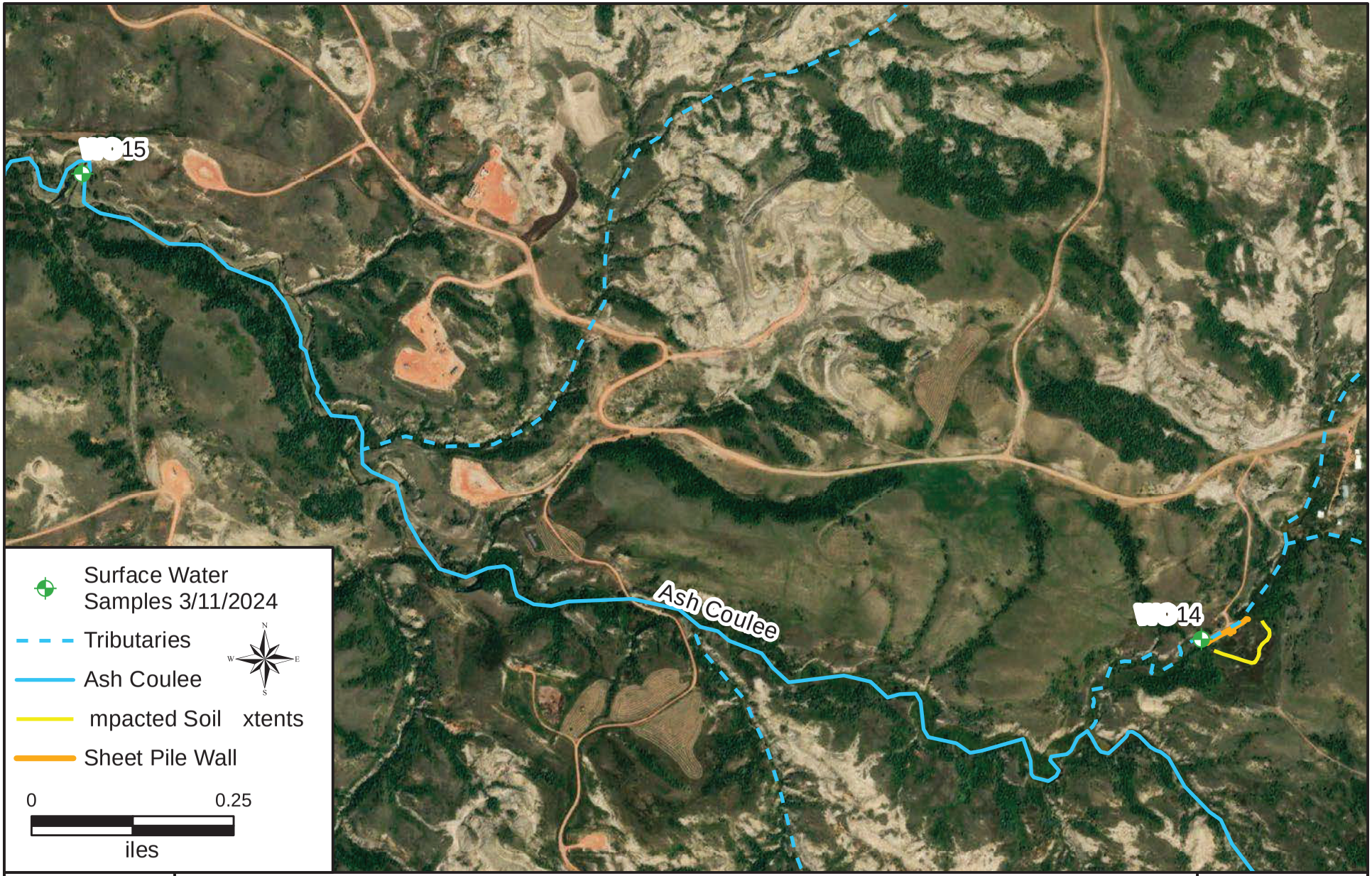
1/13/25

C24-1207
True Oil

ocations of temporary installations on the regraded hillside superimposed on a 2023 aerial photograph.

Figure 2-1

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GEOMEGA

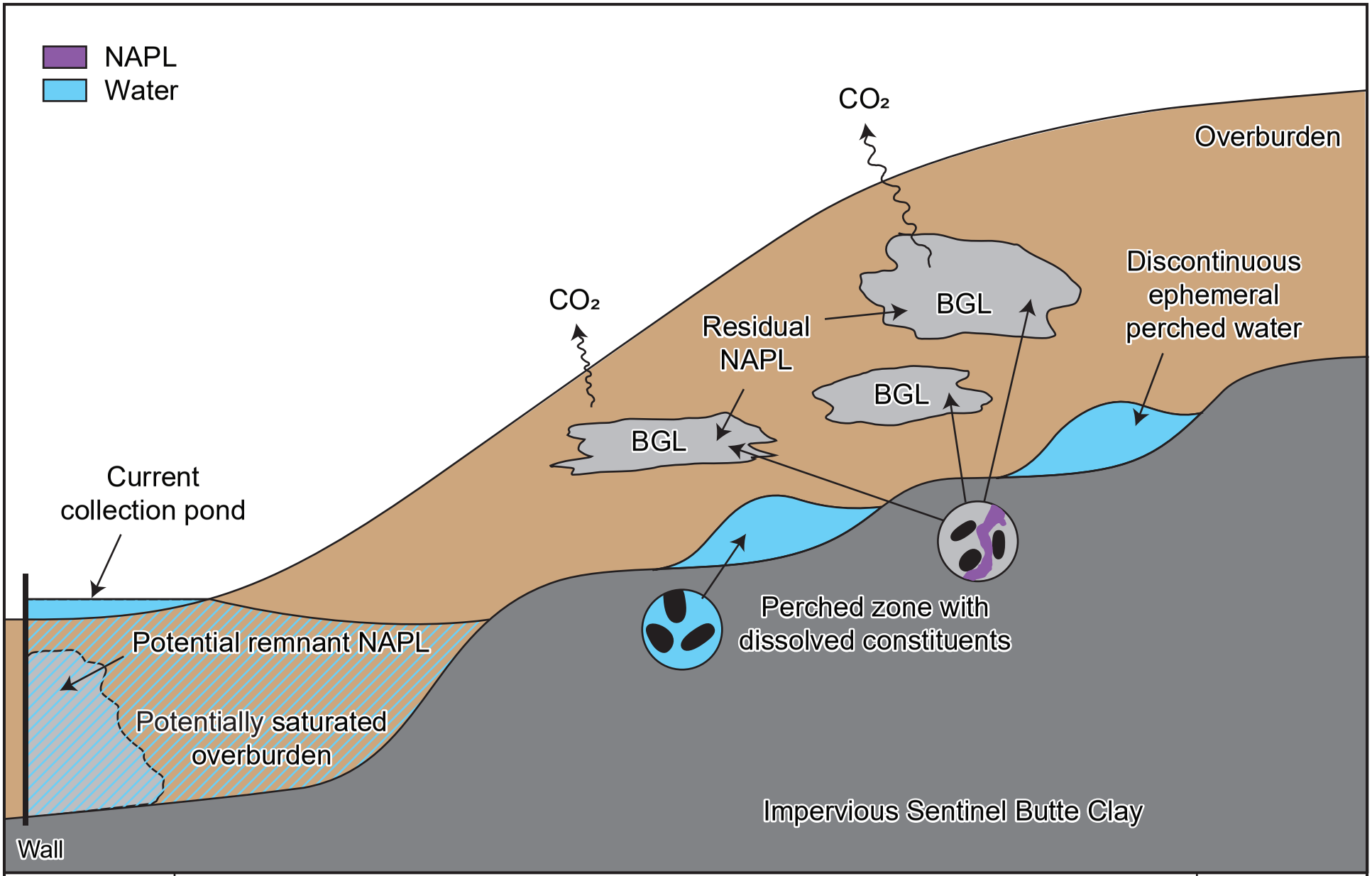
11/21/24

C24-1207
True Oil

Surface water monitoring locations downstream from the Ash Coulee site.

Figure
2-2

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GEOMEGA

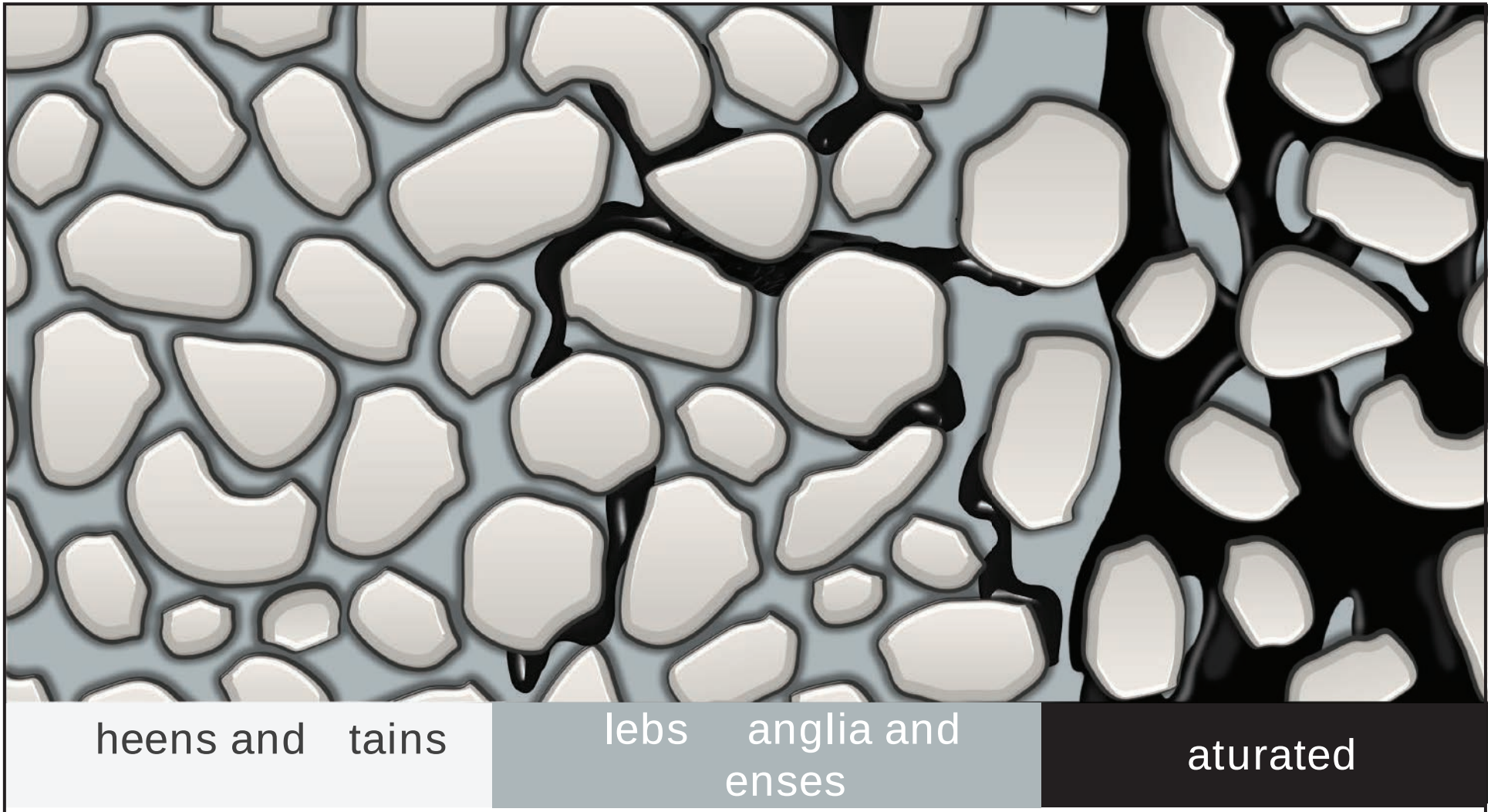
1/17/25

C241207
True Oil

Current Ash Coulee conceptual site model (not to scale).

Figure
3-1

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GEOMEGA

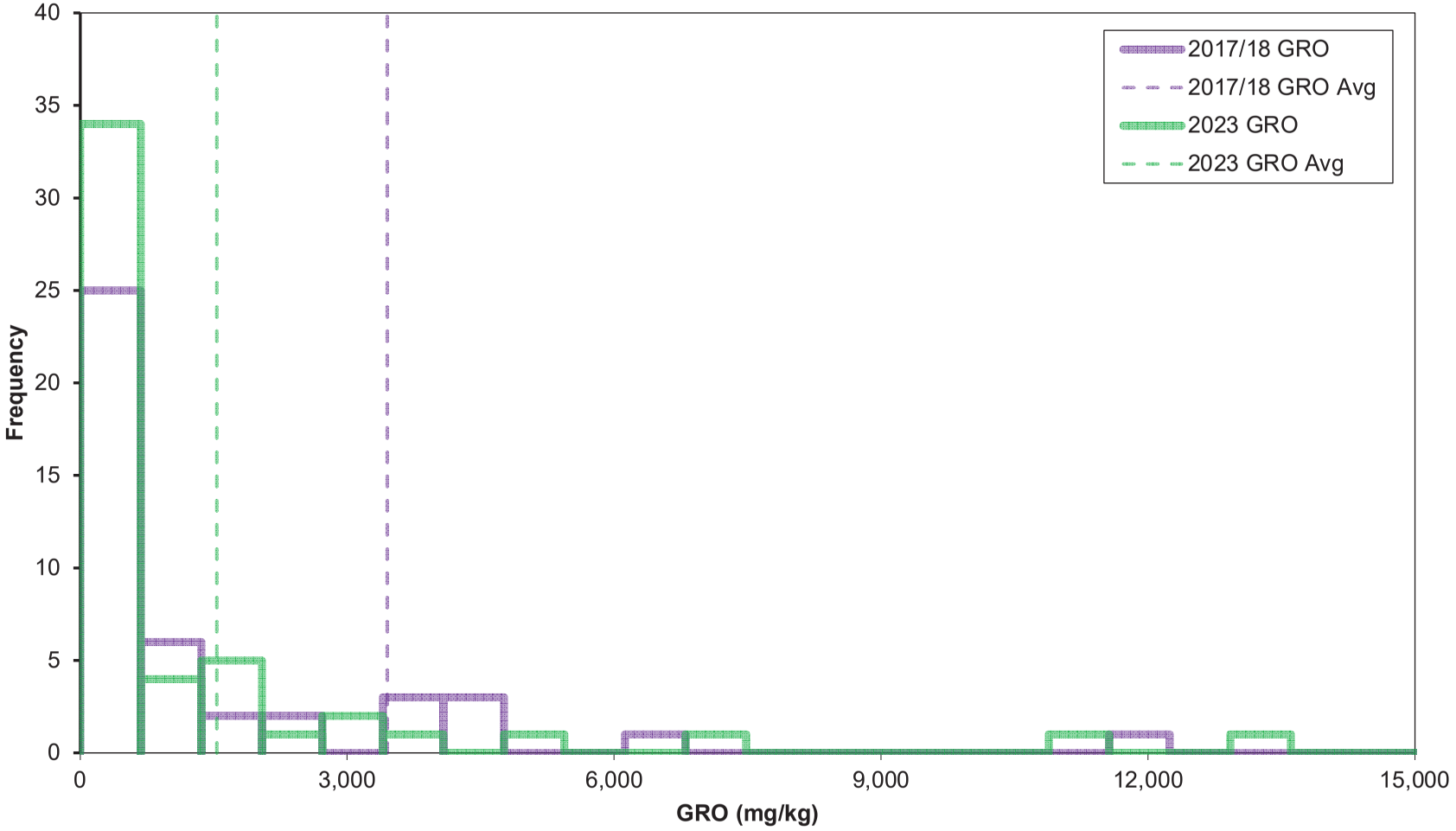
2/2 /25

C241207
True Oil

Schematic of saturated mobile AP contrasted with residual immobile blebs ganglia and lenses also showing sheens and stains.

Figure 3-2

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GEOMEGA

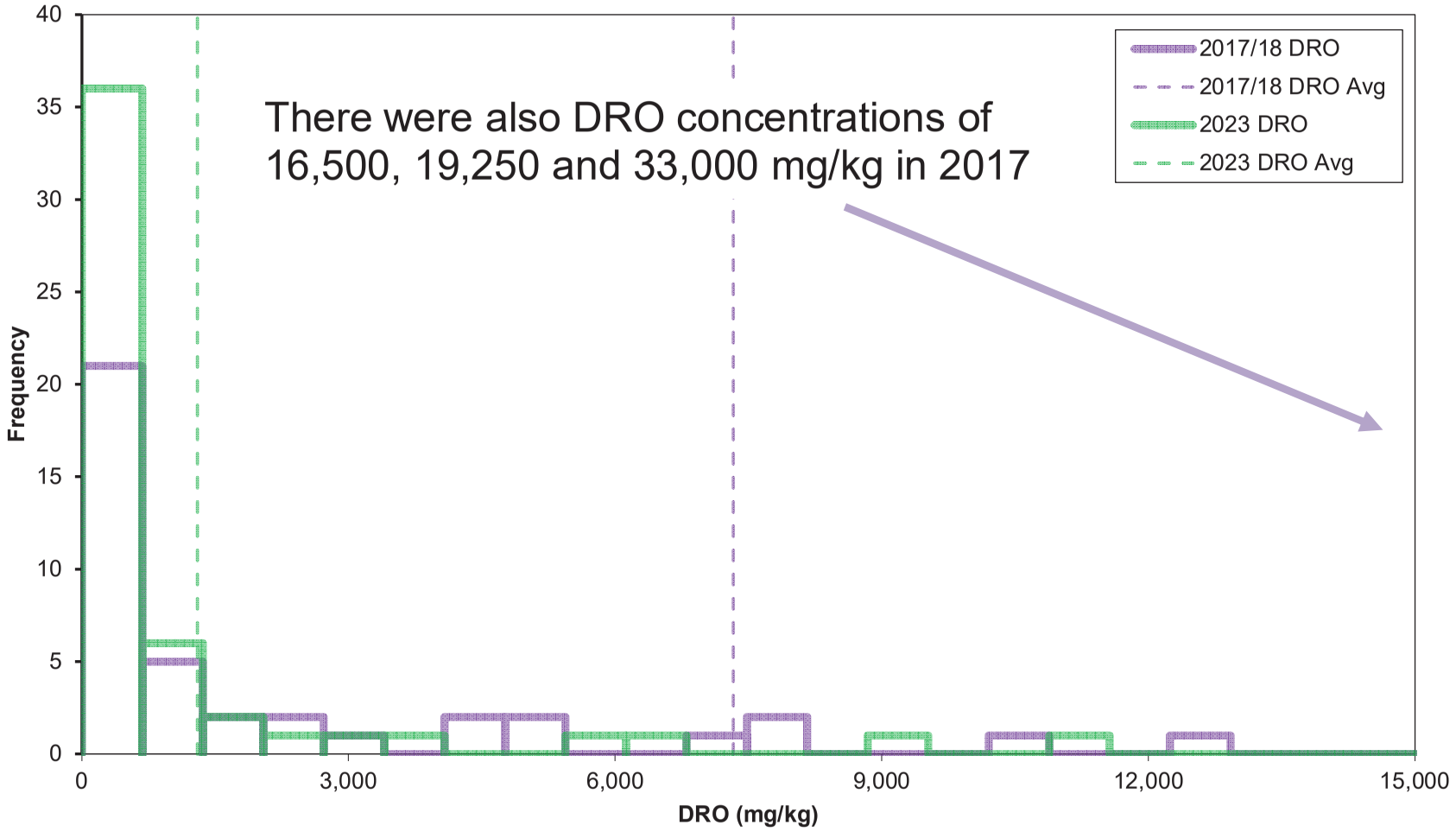
3/4/25

C241207
True Oil

The soil GRO concentration distribution in 2017/18 and 2023 showing the reduction in the average condition over the 5 year span.

Figure
4-1

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GEOMEGA

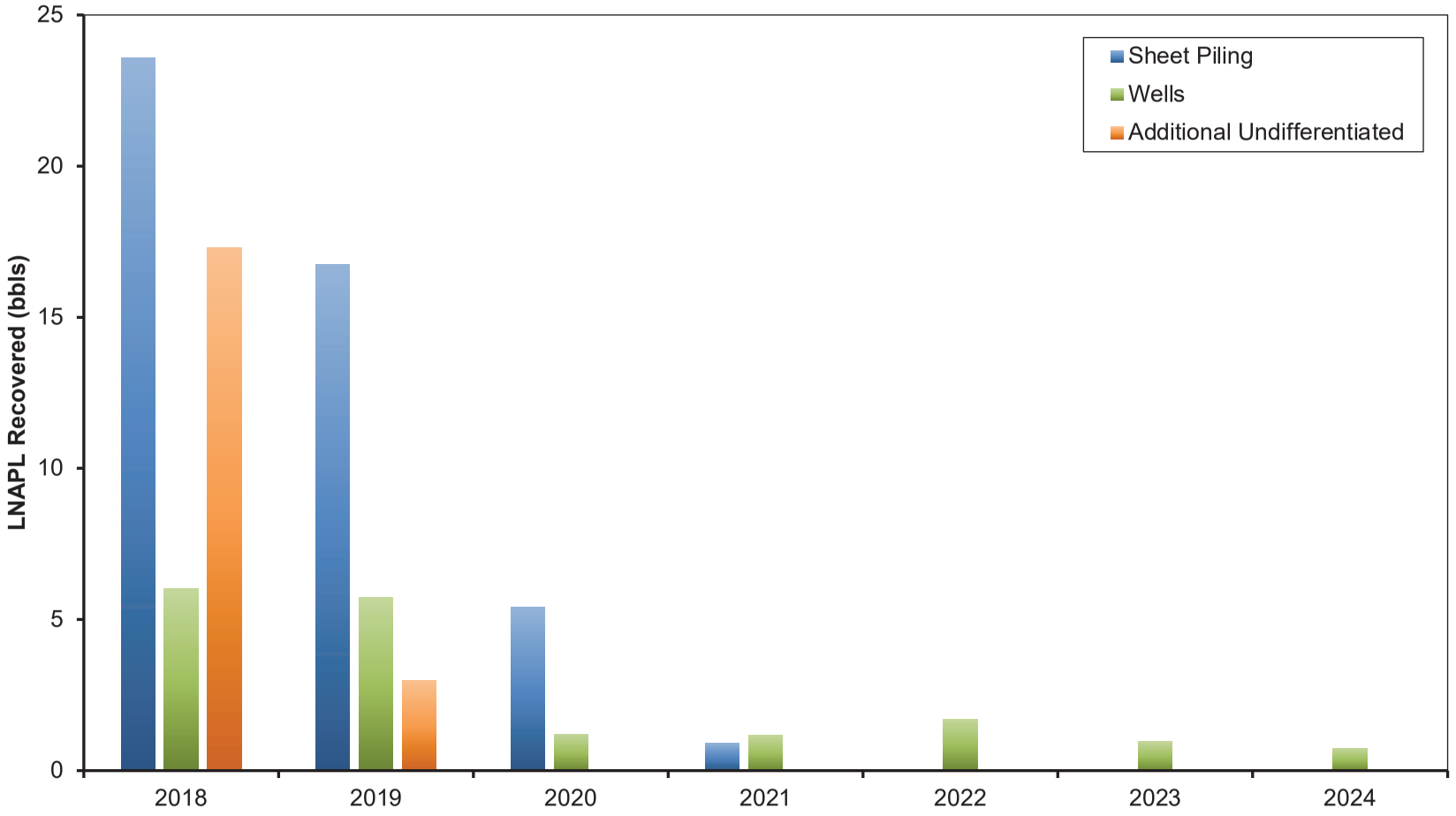
3/4/25

C241207
True Oil

The soil DRO concentration distribution in 2017/18 and 2023 showing the reduction in the average condition over the 5 year span.

Figure
4-2

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GEOMEGA

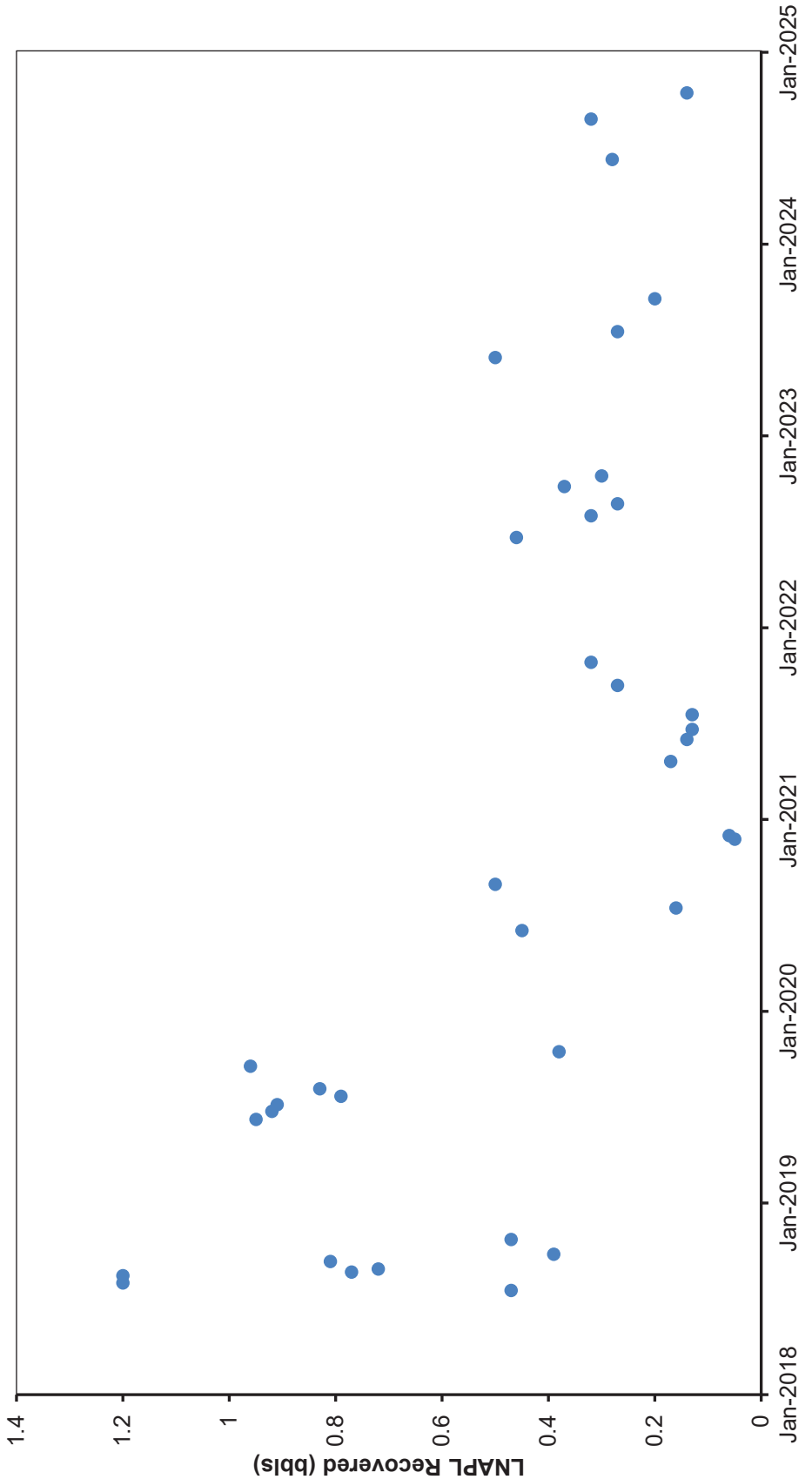
3/3/25

C241207
True Oil

LNAPL recovery behind the wall and in hillside wells demonstrating a lack of recoverable NAPL behind the wall after 2021.

Figure
4-3

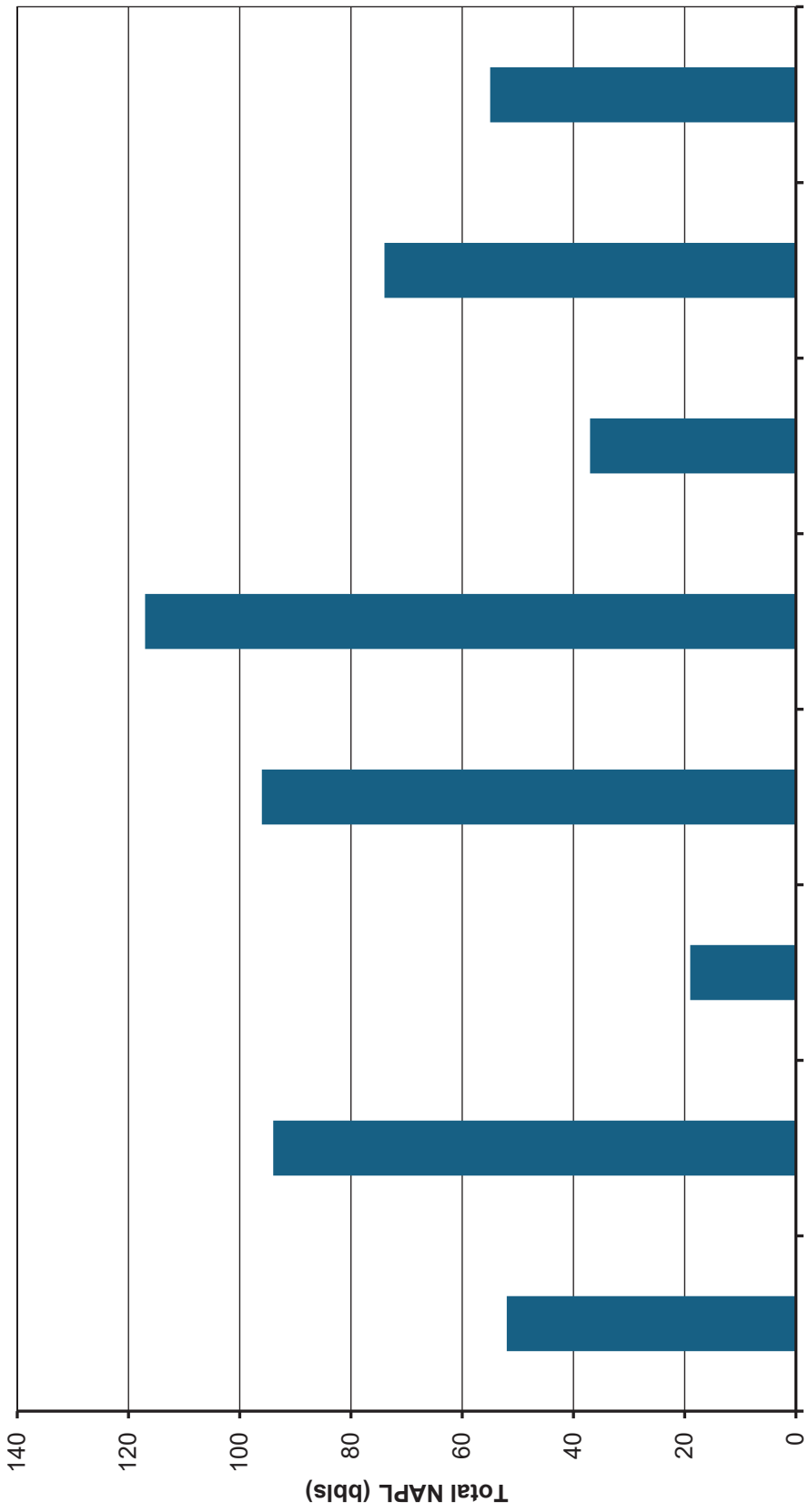
Case 1:22-cv-00089-DLH-CRH Document 54-1 Filed 09/09/26 Page 98 of 669



LNAPL recovery from the temporary wells for each recovery event.

Figure
4-4

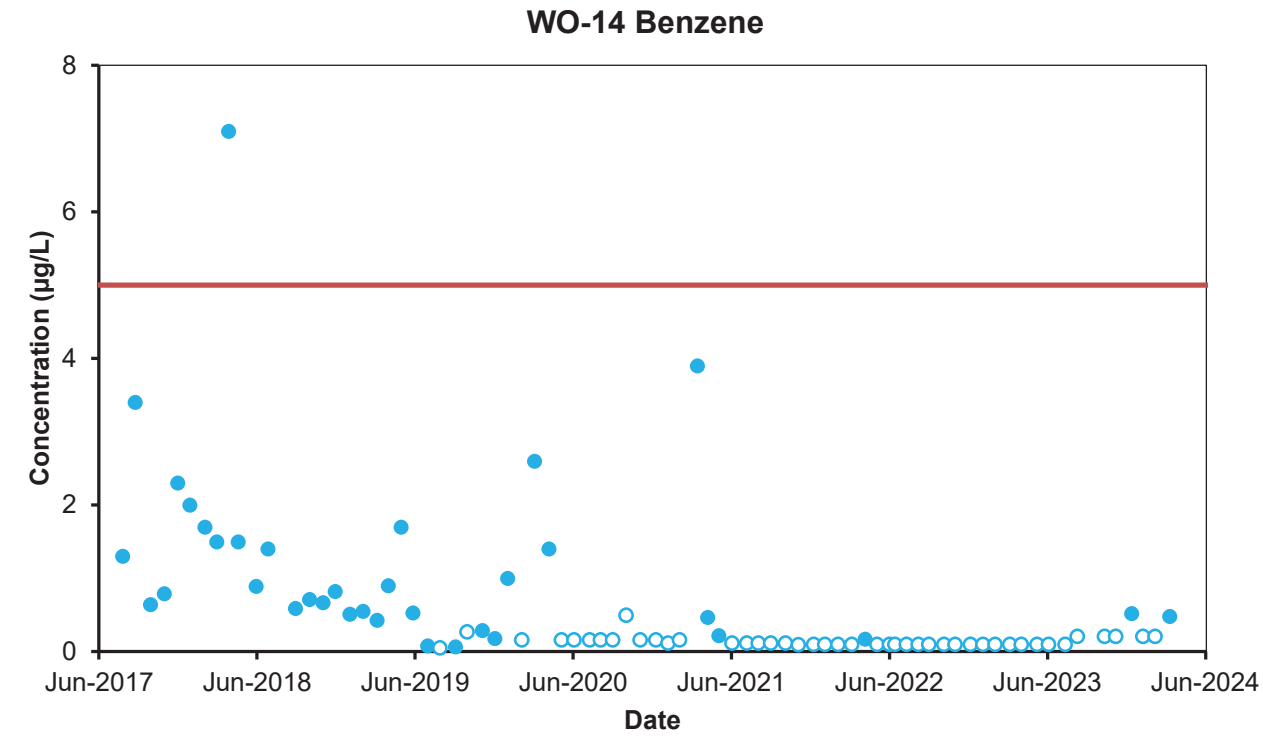
GEOMEGA
3/3/25
C241207
True Oil

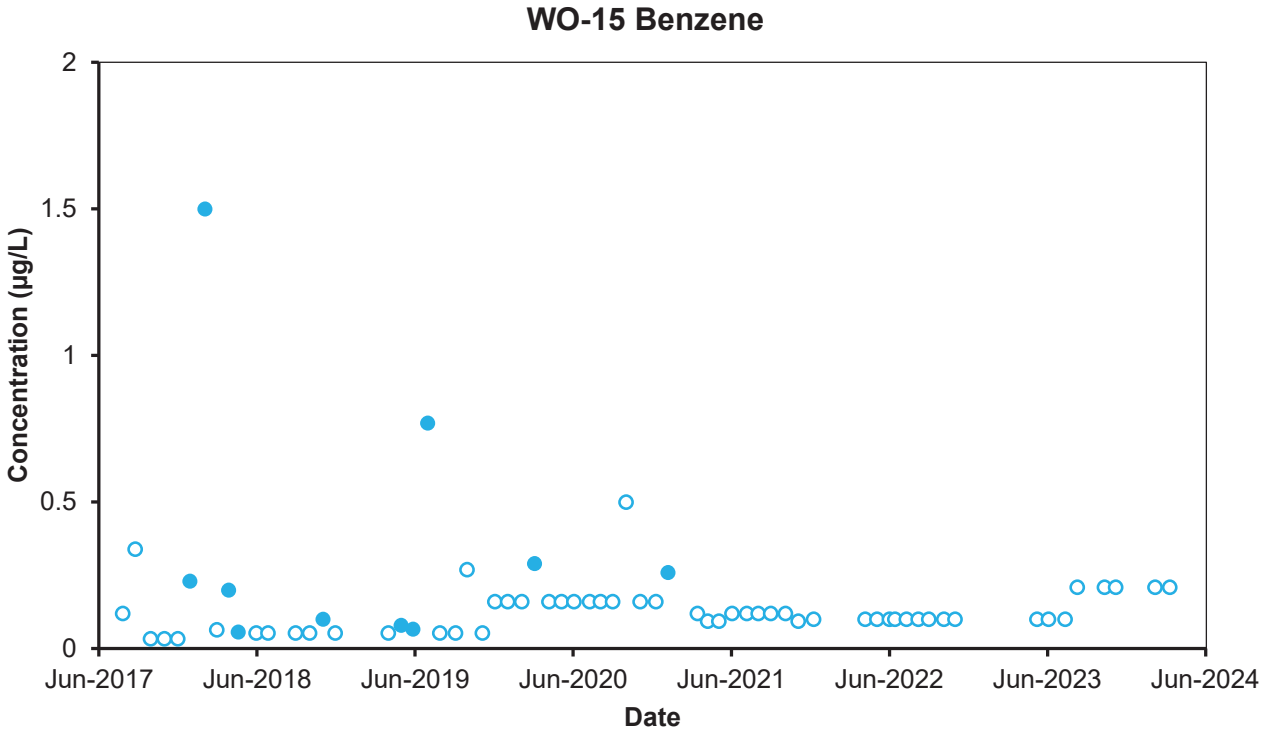


Annual hydrocarbon removal based on CO_2 collection in the efflux locations.

Figure
4-5

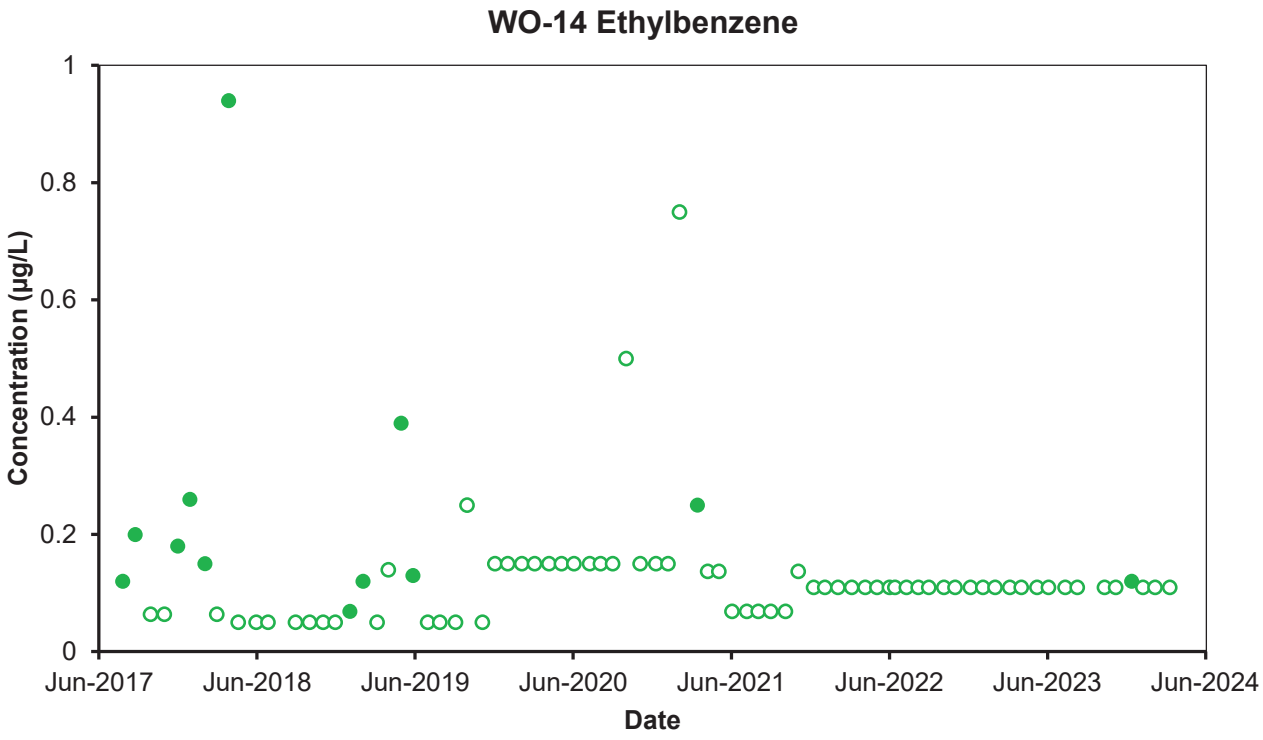
GEOMEGA
3/3/25
C241207
True Oil

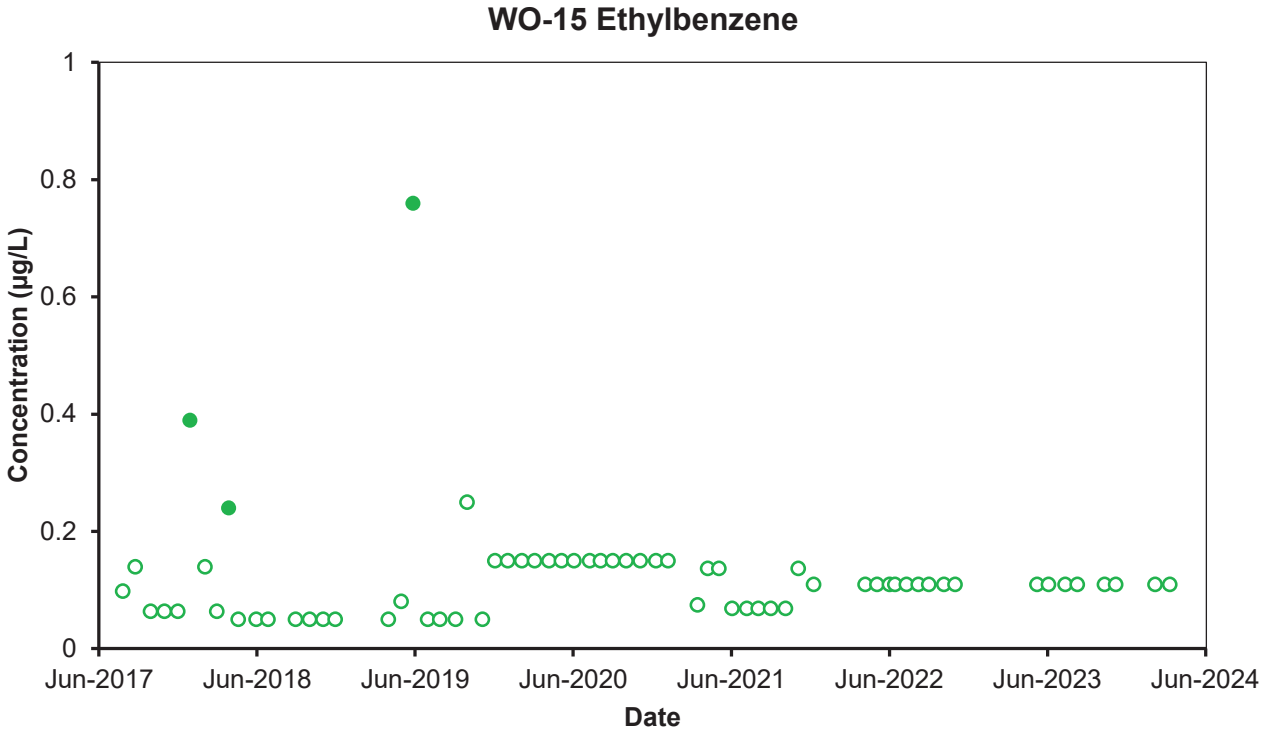




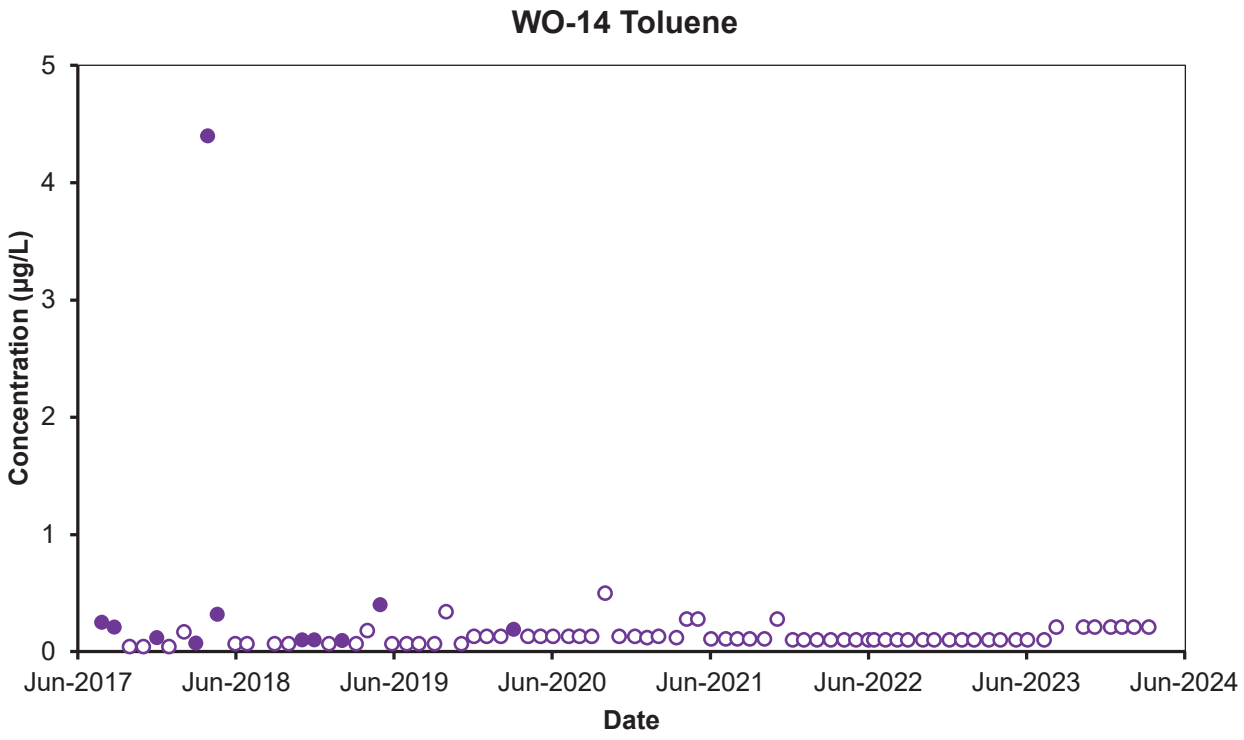


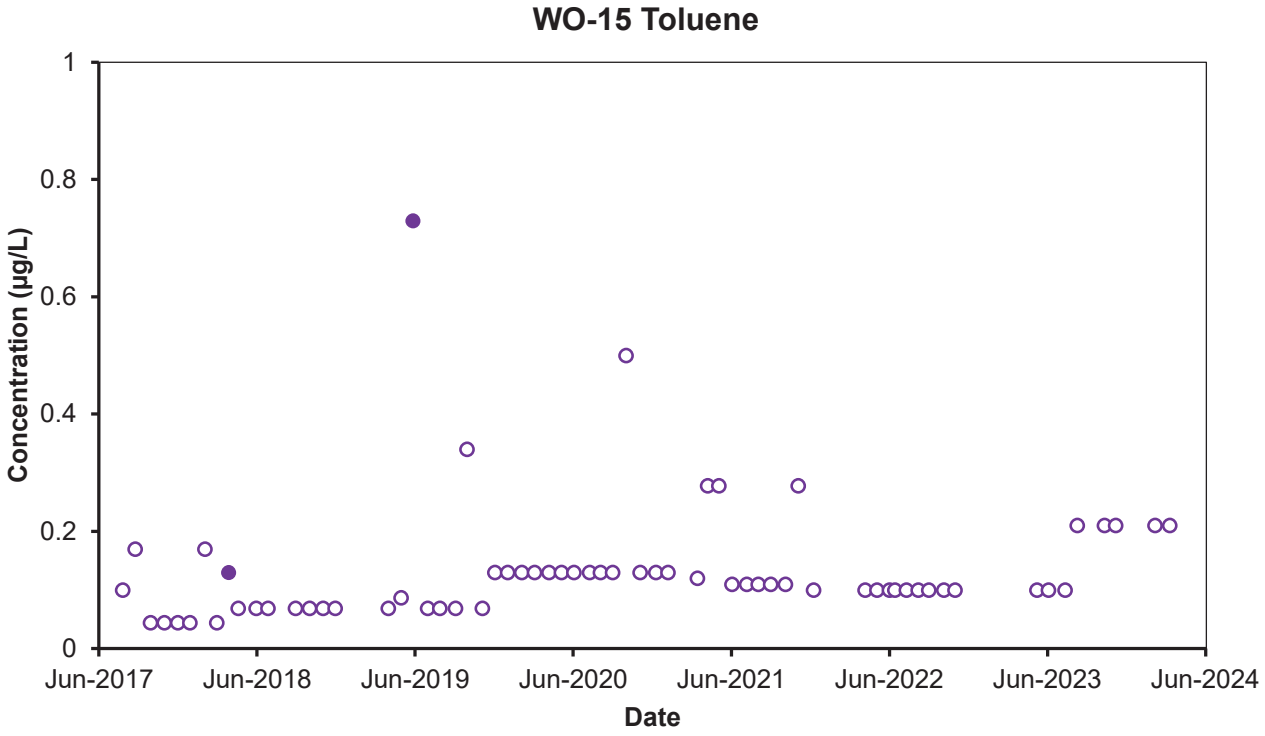
GEOMEGA 2/4/25 C241207 True Oil	Benzene in the two surface water monitoring stations (open circles are below the method limit). The RBSLs are provided on Table 4-1.	**Figure** 4-6



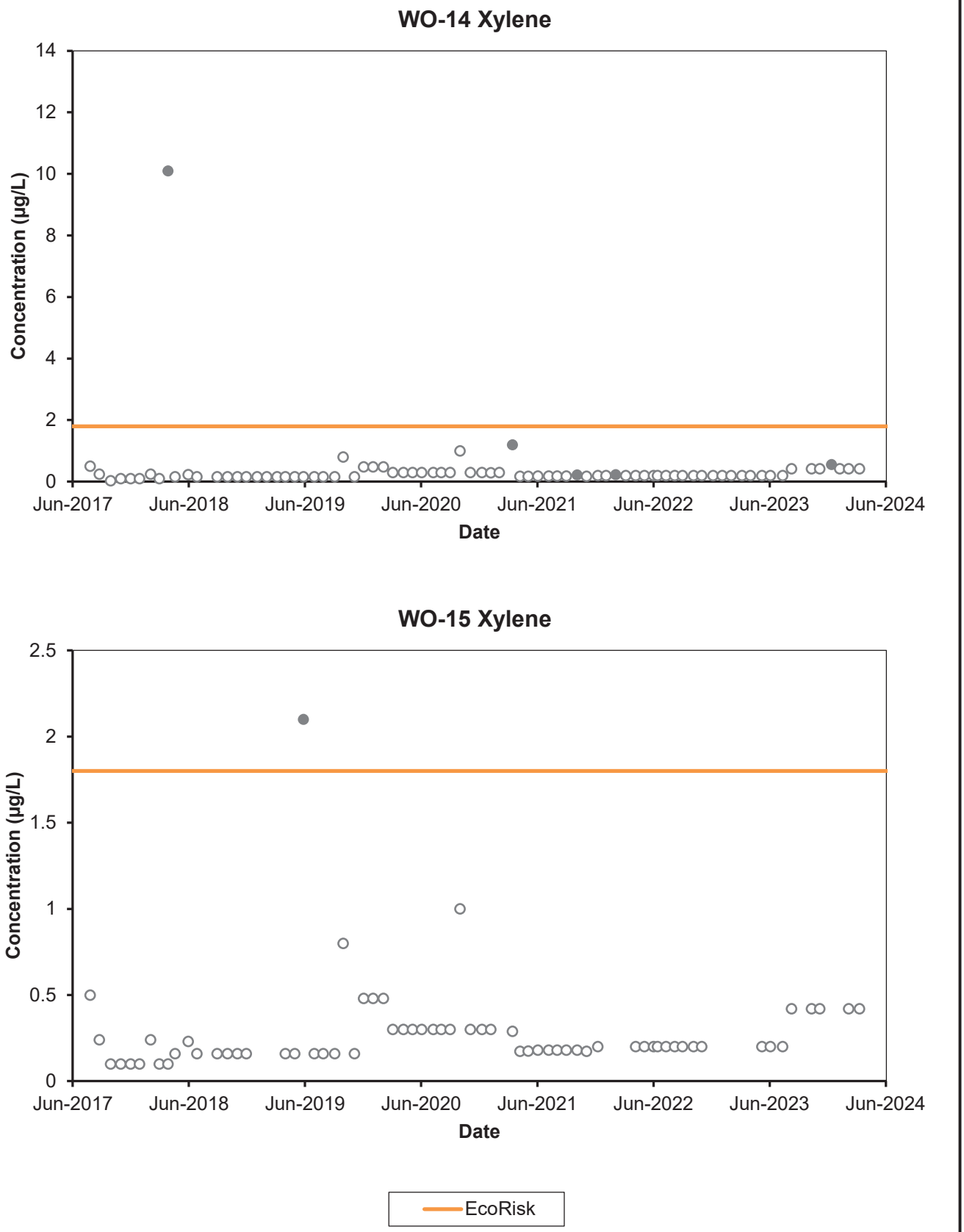


GEOMEGA 2/4/25 C241207 True Oil	Ethylbenzene in the two surface water monitoring stations (open circles are below the method limit). The RBSLs are provided on Table 4-1.	**Figure** 4-7

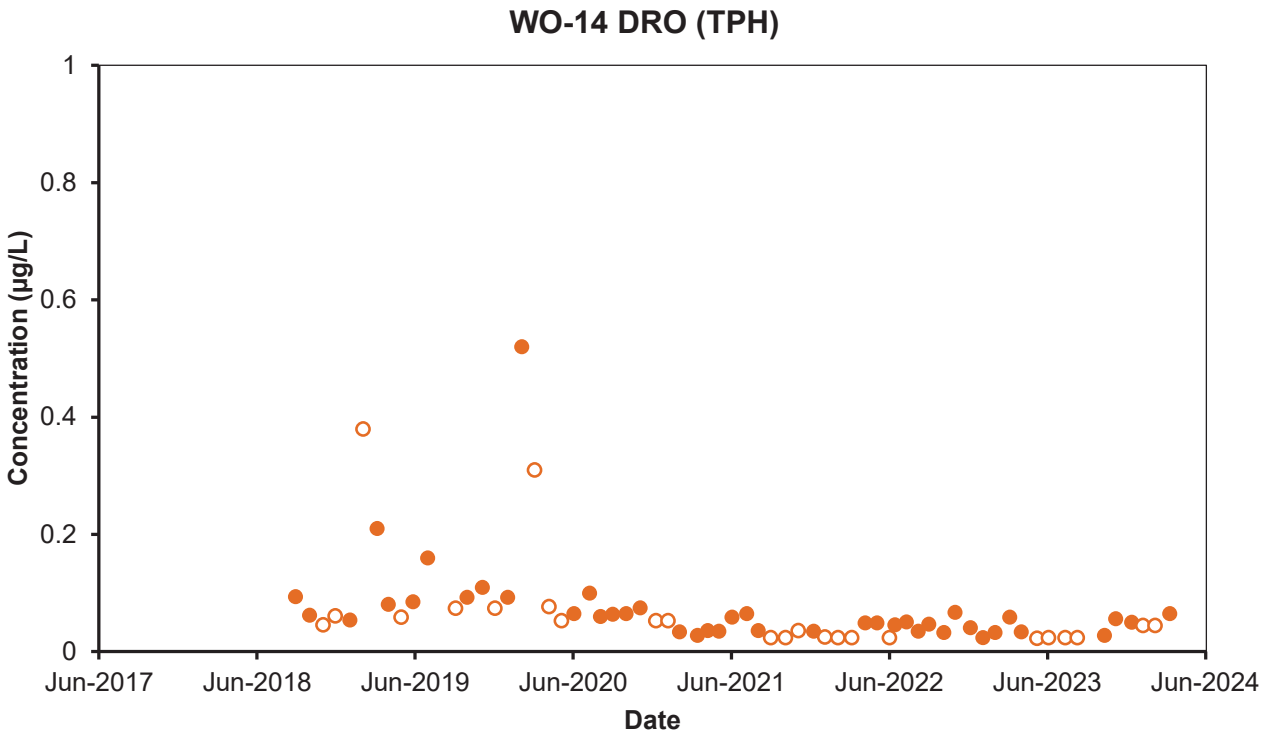


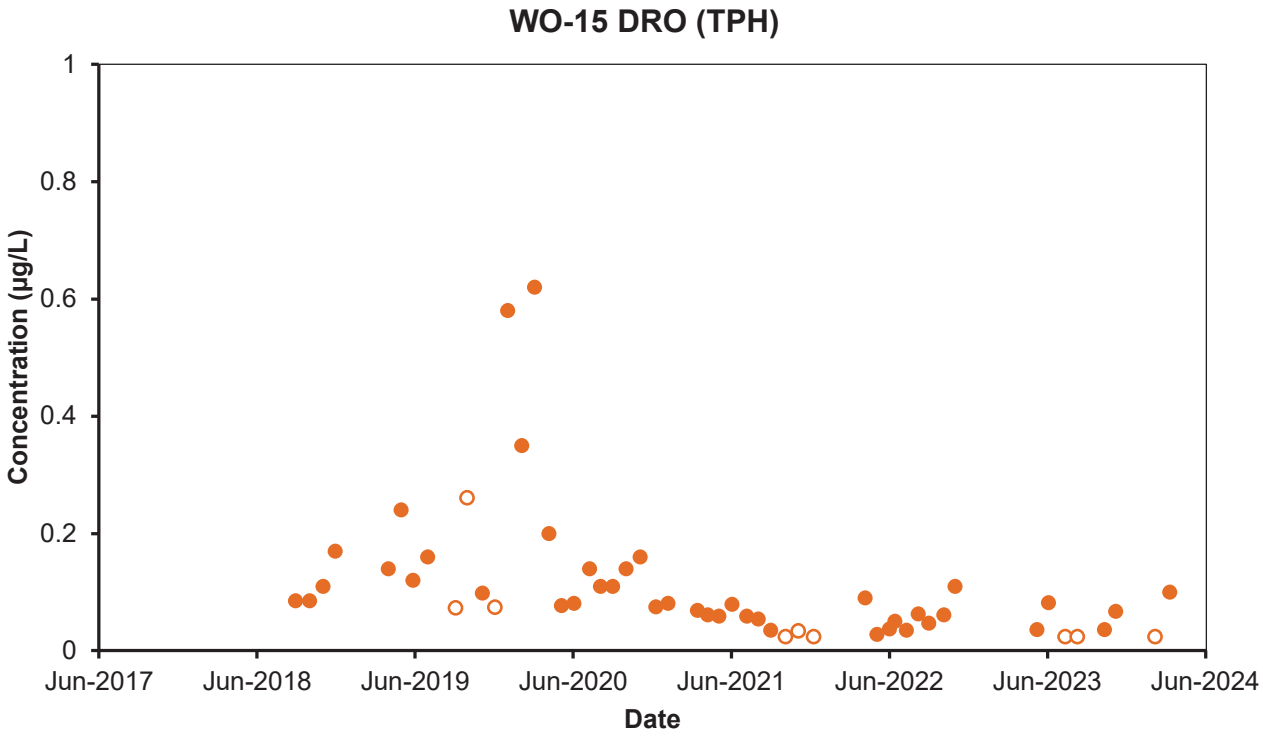


GEOMEGA 2/4/25 C241207 True Oil	Toluene in the two surface water monitoring stations (open circles are below the method limit). The RBSLs are provided on Table 4-1.	**Figure** 4-8

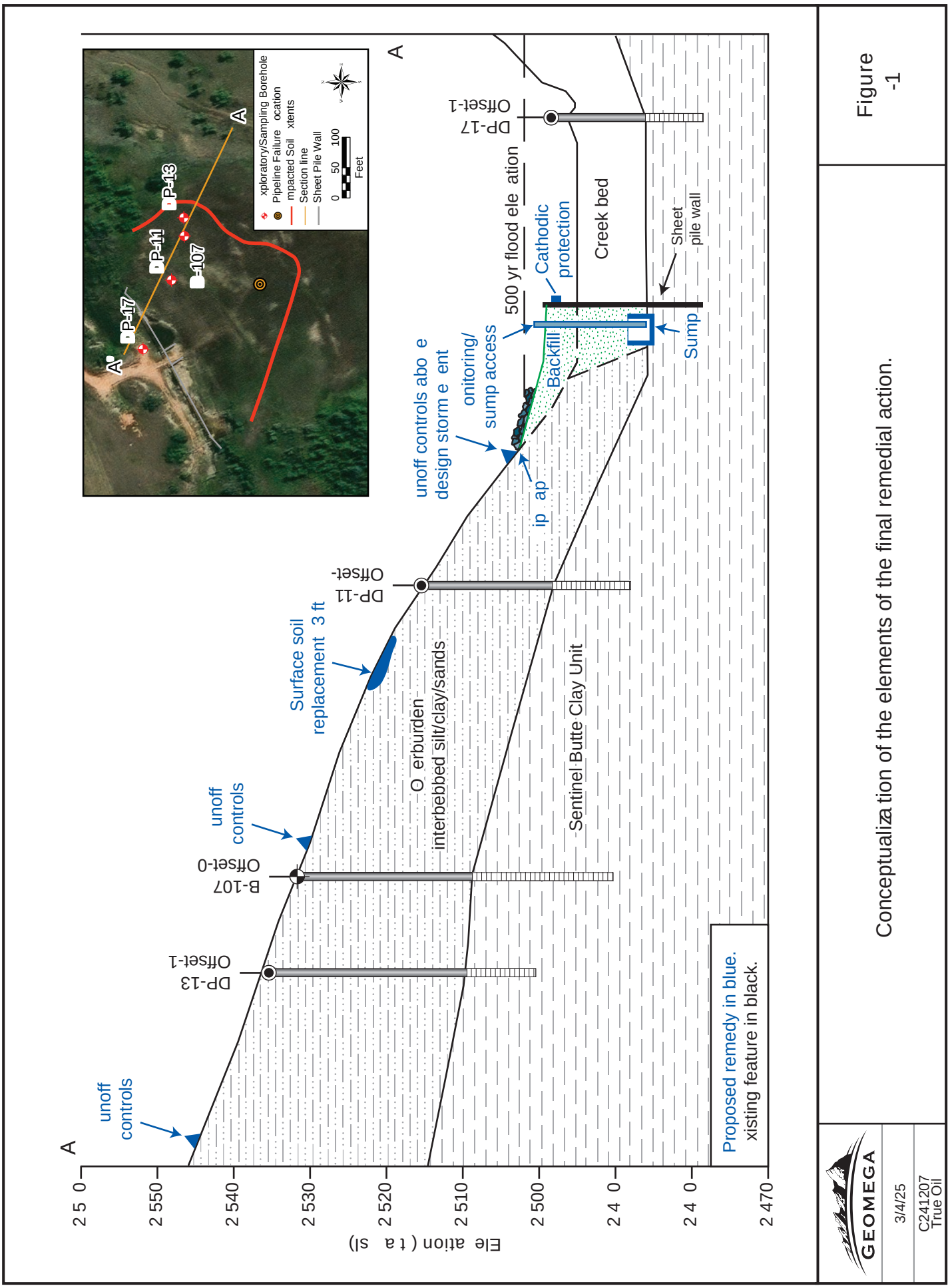


GEOMEGA 2/4/25 C241207 True Oil	Xylene in the two surface water monitoring stations (open circles are below the method limit). The RBSLs are provided on Table 4-1.	**Figure** 4-9





GEOMEGA 2/4/25 C241207 True Oil	DRO in the two surface water monitoring stations (open circles are below the method limit). The RBSLs are provided on Table 4-1.	**Figure** 4-10



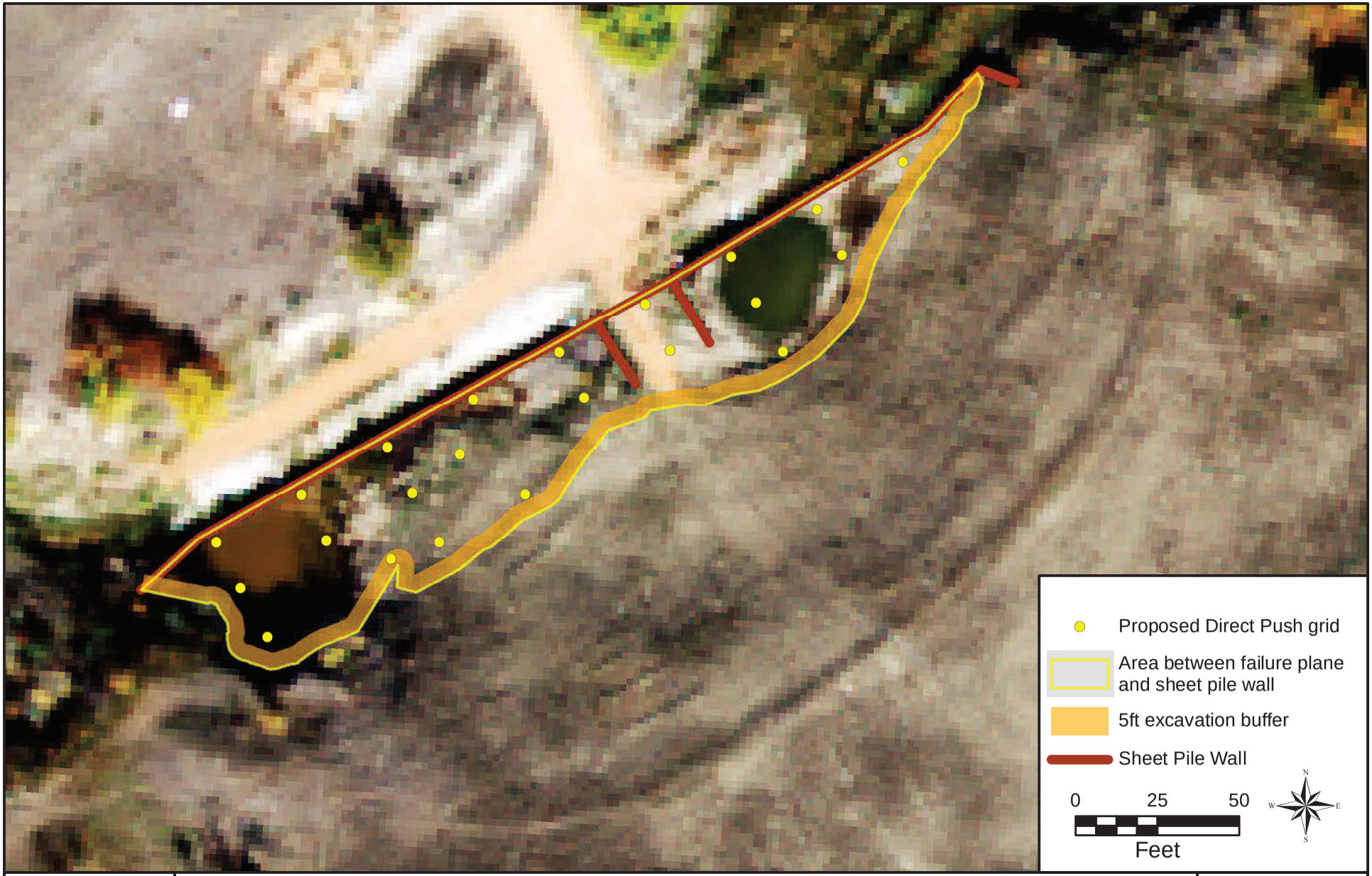
Conceptualiza tion of the elements of the final remedial action.

Figure -1

GEOMEGA

3/4/25

C241207 True Oil



GEOMEGA

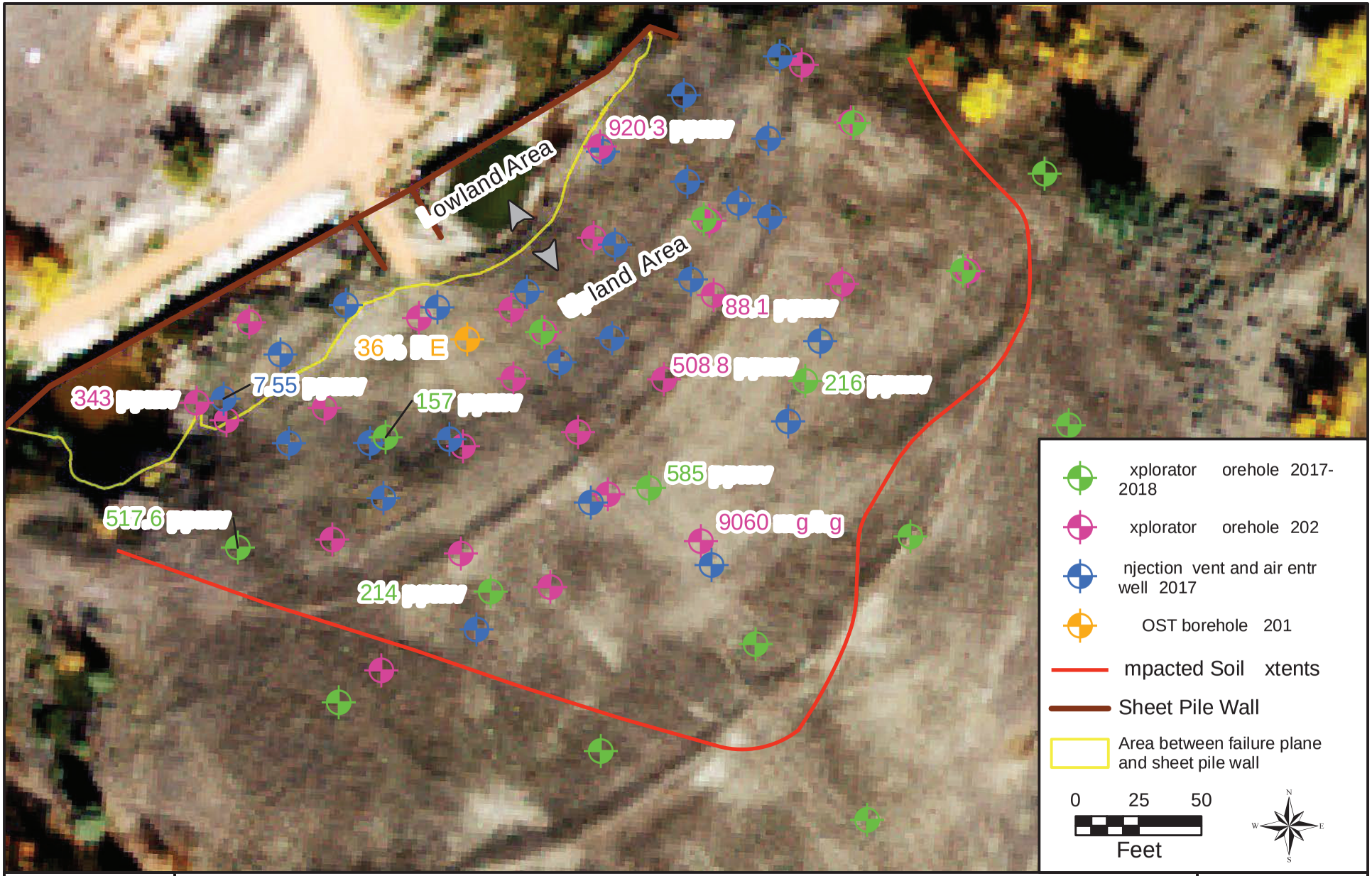
2/28/25

C24-1207
True Oil

Proposed grab sample locations to investigate the extent of TPH behind the wall subject to field verification. GPS coordinates for proposed locations are provided in Table 6-4.

Figure 6-2

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GEOMEGA

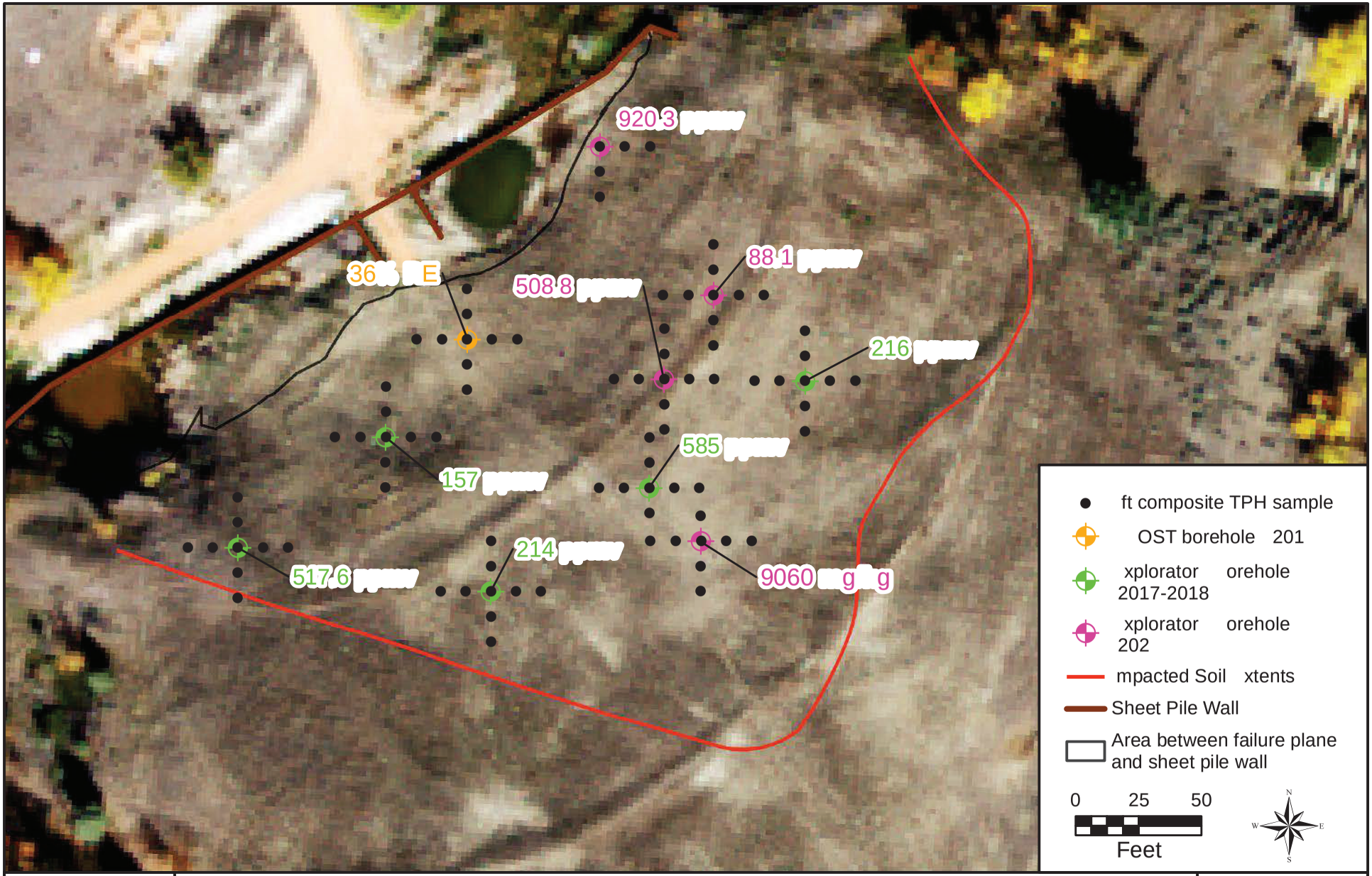
/4/25

C24-1207
True Oil

P D values 7. ppmv OST signal 25 and TPH 500 mg/kg for boreholes and wells potentiall re uiring excavation. OST anal sis and the 2017-2018 P D data were superseded b the 202 P D measurements.

Figure 6-

Case 1:22-cv-00089-DLH-CRH Document 54-1 Filed 09/09/26 Page 108 of 669



GEOMEGA

/ /25

C24-1207
True Oil

uadrant-based surficial soil sample locations with ideali ed conceptual excavation footprints contingent on the data .
GPS coordinates for proposed locations are provided in Table 6-6.

Figure 6-4

Case 1:22-cv-00089-DLH-CRH Document 54-1 Filed 09/09/26 Page 109 of 669



GEOMEGA

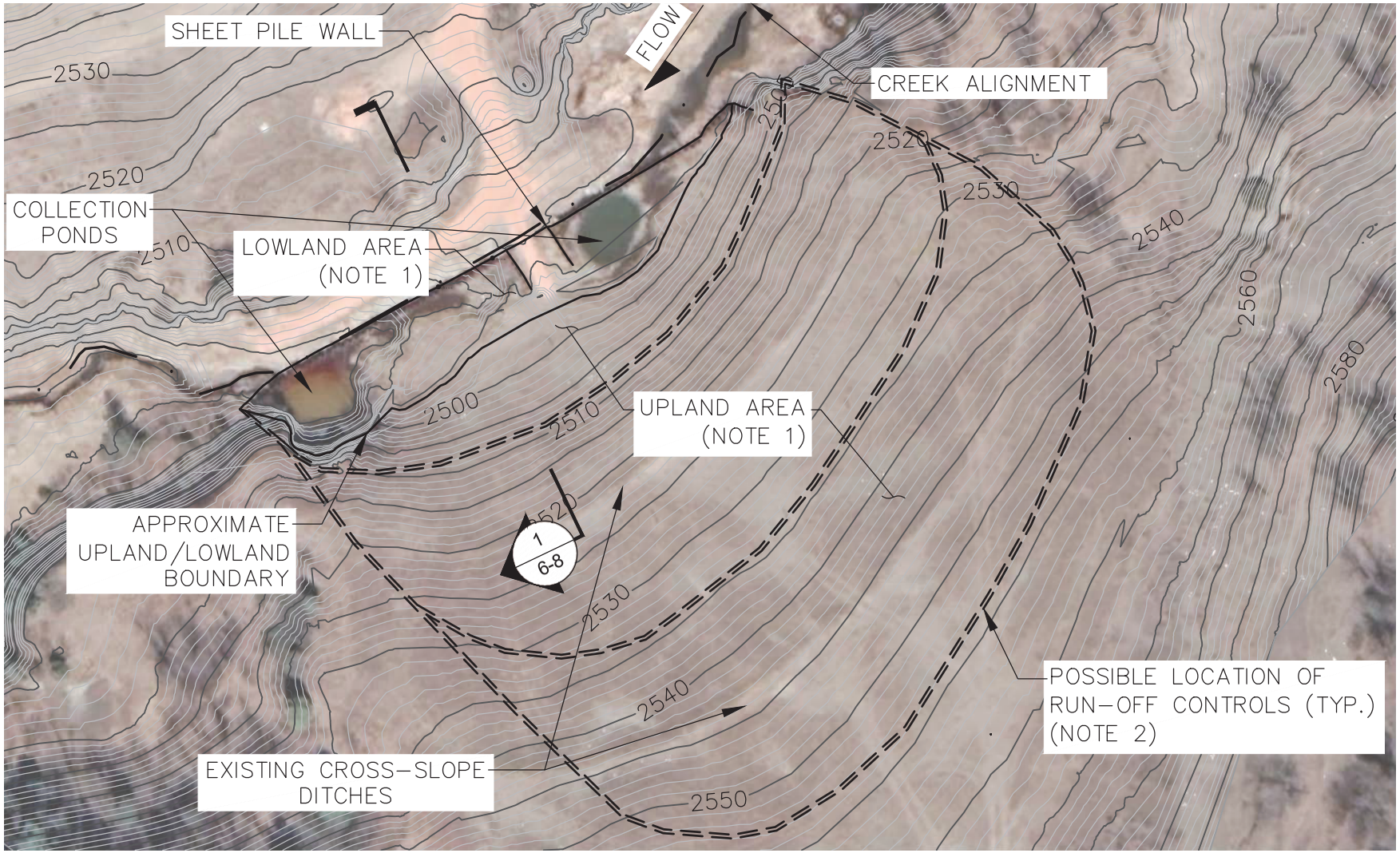
3/4/25

C24-1207
True Oil

ypothetical maximum extent of impacted surficial soils deri ed from interpolation with P D 7.3.

Figure
-5

Case 1:22-cv-00089-DLH-CRH Document 54-1 Filed 09/09/26 Page 110 of 669



0 40 80 160

SCALE IN FEET

PRELIMINARY
NOT FOR CONSTRUCTION

NOTES:

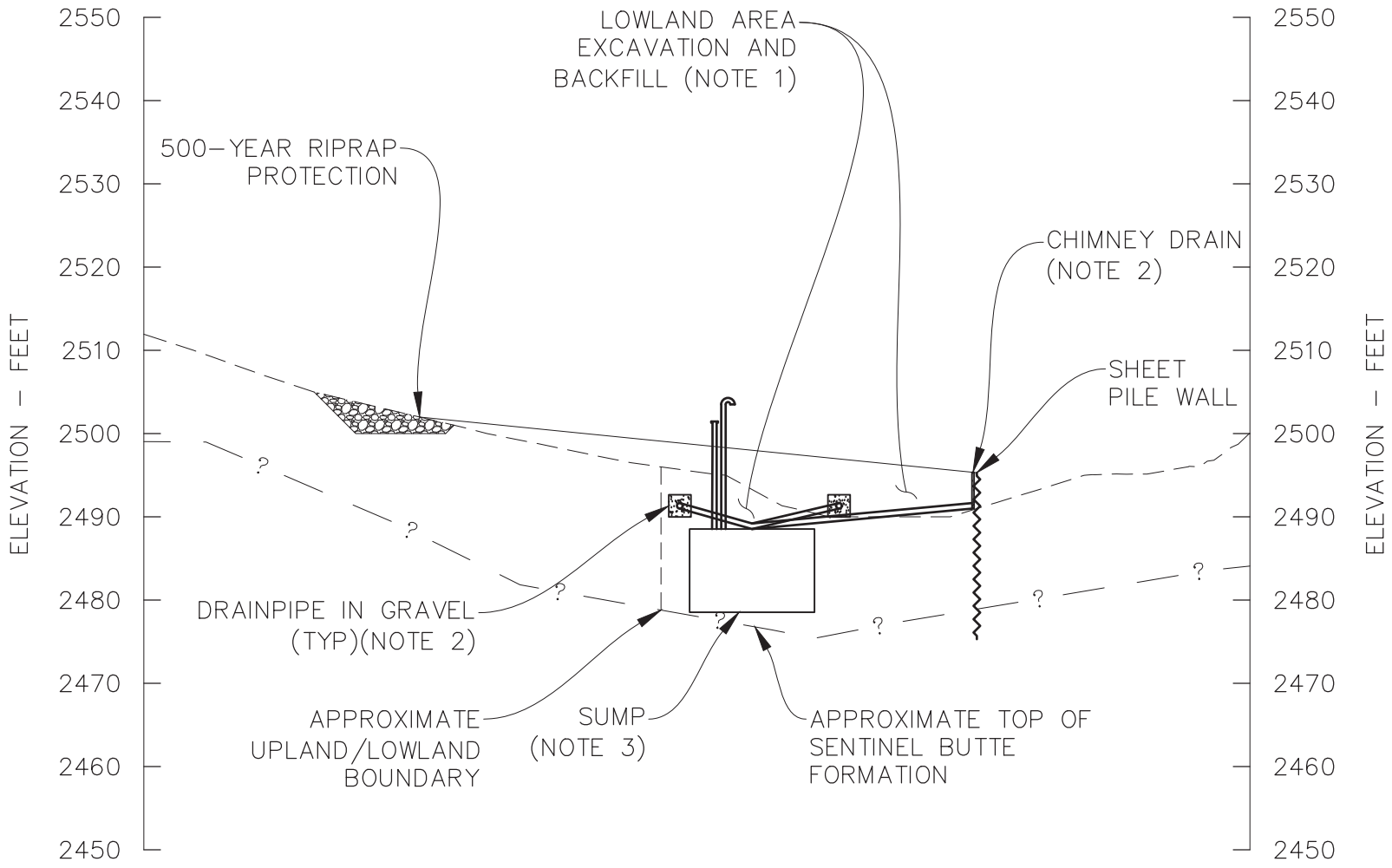
1. EXTENTS OF EXCAVATION WILL BE BASED ON RESULTS OF TPH TESTING AND STABILITY ANALYSES.
2. LOCATION OF RUN-OFF CONTROLS TO BE DETERMINED BASED ON RESULTS OF TPH TESTING AND RUN-OFF CALCULATIONS.

RJH CONSULTANTS, INC.

ASH COULEE INCIDENT WORK PLAN	LOWLAND AND UPLAND AREAS PLAN
PROJECT NO. 22148	February 2025 **Figure 6-6**

P:\22148 - ASH COULEE INCIDENT S-316.2\CAD\WORKING\22148_2025-01-23_EXCAVATION PLAN.DWG 2/3/2025 11:22 AM

Case 1:22-cv-00089-DLH-CRH Document 54-1 Filed 09/09/26 Page 111 of 669



NOTES:

1. EXTENTS OF EXCAVATION WILL BE BASED ON RESULTS OF TPH TESTING AND STABILITY ANALYSES.
2. BOTTOM OF DRAINAGE FEATURES WILL BE SET AT THE ELEVATION OF THE CREEK.
3. SUMP WILL BE SIZED TO REQUIRE PUMPING NO MORE FREQUENTLY THAN EVERY 5 YEARS.

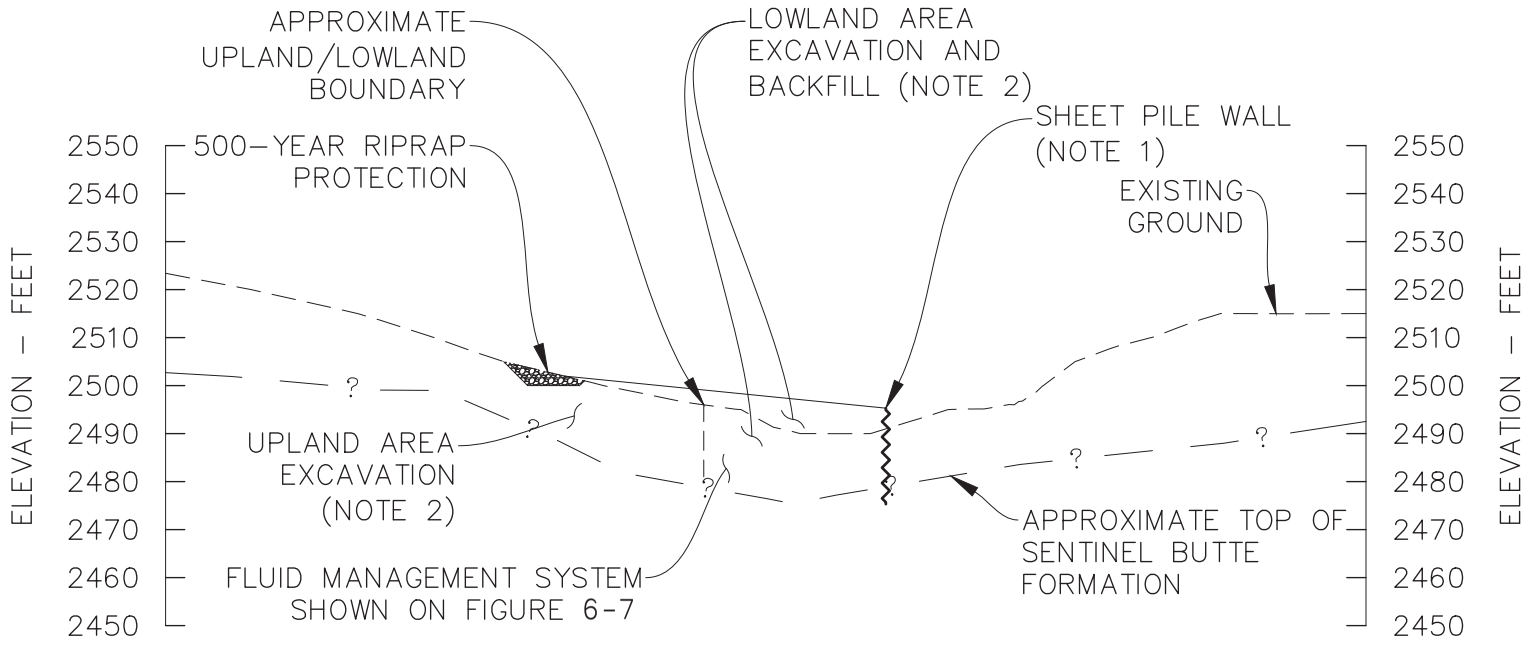
0 10 20 40
SCALE IN FEET

RJH CONSULTANTS, INC.

ASH COULEE INCIDENT WORK PLAN	FLUID MANAGEMENT SYSTEM
PROJECT NO. 22148	February 2025 **Figure 6-7**

P:\22148 – ASH COULEE INCIDENT S–316.2\CAD\WORKING\22148_2025–01–23_EXCAVATION PLAN.DWG 2/3/2025 11:22 AM

Case 1:22-cv-00089-DLH-CRH Document 54-1 Filed 09/09/26 Page 112 of 669



SECTION 1 / 6-6

0 20 40 80
SCALE IN FEET

NOTES:

1. SHEET PILE SEGMENTS WERE 20 FEET LONG.
2. EXTENTS OF EXCAVATION WILL BE BASED ON RESULTS OF TPH TESTING AND STABILITY ANALYSES.

RJH CONSULTANTS, INC.

ASH COULEE INCIDENT WORK PLAN	LOWLAND AREA SECTION
PROJECT NO. 22148	February 2025 **Figure 6-8**

P:\22148 - ASH COULEE INCIDENT S-316.2\CAD\WORKING\22148_2025-01-23_EXCAVATION PLAN.DWG 2/3/2025 11:25 AM

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GEOMEGA

2/3/25

C241207
True Oil

Photograph of a sacrificial anode welded to a sheetpile wall.

Figure
6-9

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Appendix A

memorandum

To:	Belle Fourche Pipeline Company
From:	Trihydro Corporation
Date:	March 4, 2025
Re:	Ash Coulee Incident; Billings County, North Dakota Standard Operating Procedure – Field Documentation

1.0 PURPOSE, SCOPE, AND RESPONSIBILITIES

This standard operating procedure (SOP) describes requirements associated with documenting field investigation and remediation activities. These procedures apply to field logbooks, sample labels, and chain-of-custody documentation.

The Operational and Service Excellence (OSE) Business Unit is responsible for SOP maintenance, management, and revisions. Trihydro employees performing tasks within this SOP are responsible for meeting SOP requirements. For projects where activities within this SOP are necessary, the project manager (or designee) is responsible for ensuring that those activities are conducted in accordance with this and other SOPs. Project team members are responsible for documenting procedural information in sufficient detail (i.e., calculations, field notes, reports, etc.) and reporting these changes to OSE. Such documentation will be included as a component of project records.

2.0 PROCEDURES

Proper field documentation is a crucial part of the field investigation and remediation process. Documentation should be maintained to trace the possession and handling of samples from the time of collection through submittal to the laboratory, to re-establish sampling locations if needed, to record sampling methods and equipment, and to identify field personnel responsibilities. Field documentation procedures are important from both the technical and legal perspective.

This SOP provides guidance that can be adapted to site-specific procedures. Contact the Project Manager to tailor the procedure based on the specific project. Additional, site-specific documentation may be found in the project's sampling and analysis plans (SAP), quality-assurance project plans, and work plans.

2.1 Field Logbook

Field team members conducting sampling activities shall maintain a field logbook and/or field forms to document activities conducted by the field team each day. Any corrective actions or alterations of the prescribed preparation and/or sampling procedures will also be noted. Entries on all forms and logbooks should be made in indelible ink. A single stroke should be used to cross out incorrect information and initialed by the sampler. A single stroke with the field personnel's initials shall be used to manage unused



space left on a page. A new day's entry shall start with a new page in the logbook. Field logbooks will be maintained in accordance with the procedures listed in Section 2.4.

Sections of the applicable field forms (**Attachment A**) should be filled out by members of the sampling team. Documentation will include the date of sampling, sample location, and sample identification. The sample-location coordinates obtained from the hand-held GPS will also be included on the field sampling forms. Any corrective actions or alterations of the prescribed preparation and/or sampling procedures will also be noted. Entries on all forms and logbooks should be made in indelible ink. A single stroke should be used to cross out incorrect information and initialed by the sampler.

Photographs will be used to substantiate and augment the field notes. Photographs will be numbered and recorded in the logbook or Photograph Log Form (**Attachment B**).

At a minimum, the following information shall be recorded in the field logbook:

- Name and location of the site
- Date(s) of sample collection events
- Name and affiliation of sampling personnel
- Name of field team members and responsibilities (if others)
- Daily time of arrival to the site
- Daily weather conditions
- Pertinent field observations
- Daily summary of field activities
- Daily summary of equipment-preparation procedures (notation of equipment calibration and maintenance), if appropriate
- Time of sample collection for each sample
- Sample locations and types of samples collected and sample-identification numbers
- Sample-collection depths, if applicable
- Sample description, if applicable
- Project quality-control samples (i.e., Field Duplicates, Matrix Spike/Matrix Spike Duplicates, Field Blanks, Equipment Blanks, Trip Blanks)
- A description of sampling methodology by reference to the project-control documents (Field Sampling Plan, Project Plan, SOPs)



- Corrective actions or alterations of the prescribed preparation and/or sampling procedures
- Specific sampling characteristics (e.g., moisture content, depth, temperature, turbidity, total organic vapor) as outlined in specific work plan
- Physical description and sketch/photograph of the sample-collection location(s)
- A Global Position System (GPS) reference to the collected data, if applicable
- Record of daily phone calls and/or contact with individuals at the site
- Management or disposal of investigation-derived waste

2.2 Sample Labels

Sample labels should include:

- The unique sample-identification number
- Sample location
- Parameter sampled
- Date and time sampled
- Sampler's initials
- Preservative used (if applicable)
- Site name or location
- Bottle types

Sample containers must be pre-labeled with as much of this information as possible before departing for the field. Any remaining information (such as sample time) should be filled out immediately prior to sample collection.

2.3 Chain-of-Custody Documentation

The chain-of-custody (CoC) form is intended to be a legal record of possession of samples for laboratory analysis. The CoC form will be created during pre-job preparations. The CoC form will be provided to the field-sampling personnel prior to sampling activities and should accompany sample bottles to the field site. The CoC form should be completed by field-sampling personnel at the time of sample collection and should include the name of the person responsible for the secure and appropriate handling of the samples.

The Project Manager should maintain the CoC form during sample collection activities. Care should be taken during the CoC process so that the samples listed on the CoC form match what is provided in the cooler. Additionally, one individual CoC form shall be completed per sample cooler submitted and all



samples need to be accounted for during storage. The minimum information required for CoC documentation includes:

- Name and location of the site
- Name and affiliation of the sampling personnel
- Sample-identification number
- Matrix and type of sample collected (grab or composite)
- Number of containers per sample
- Preservatives or fixatives used
- Date and time of samples collected
- Parameters to be analyzed
- Identification of couriers
- Identification of laboratory
- Custody seal numbers, if applicable

When completing CoC forms, field personnel shall properly relinquish the samples to the chosen courier or laboratory if delivered directly.

2.4 Field Records Management

Field records must be managed according to the Quality Management System manual, SAP, and/or Work Plan. In addition to the original CoC form that accompanies each sample shipment, a copy of each CoC form must be provided to the master project file. A working copy of the CoC form shall be retained in working files in the field-sampling work area for reference. The Project Manager will maintain a list of people requiring courtesy copies of the CoC form. Courtesy copies may be distributed by either hard copy (mail) or electronic copy (e-mail) and shall be distributed the next working day after sample collection.

The receiving laboratory may provide a completed copy of the CoC form as part of data deliverables or as part of routine sample-receipt notification (usually by e-mail). A copy released as part of data deliverables will become part of the project files. Any electronic copy may be printed and retained as a working copy in the field-sampling work area for reference.

Field logbooks shall have a unique identifier and shall have pre-numbered pages. Logbooks carried into the field shall have completed pages copied to project files on a weekly basis to minimize potential data



loss caused by accidental loss or destruction. Copies shall be reviewed for legibility prior to storing electronically. Refer to Section 2.1, "Field Logbook," for additional logbook details.

2.5 Photographs

Photographs will be used to substantiate and augment the field notes. For each photograph taken, the following items should be recorded in the field logbook:

- Photographer's name or initials
- Date and time of photograph
- General direction or orientation of the photograph (e.g., view toward the west or east)
- Brief description of the subject and fieldwork shown in the photograph
- For digital photographs, the sequential number of the photograph, file name, file location, and backup disc information (if applicable)
- For printed photographs, the sequential number of the photograph or specific file name

Follow these best practices when submitting photographs for the project notes:

- If you take photographs of sample characteristics and routine sampling activities, include a scale in the image and avoid using telephoto or wide-angle shots.
- If photographing a borehole location or a pole-mounted transformer, include a background object to show the location.
- Avoid photographing only a hole in the ground or a transformer showing only the sky.

Photographs will be numbered and a description of each will be recorded in the photograph log form (Appendix B). After completing field-sampling events, the Project Manager should submit all photographs for development and subsequent storage in the project files.

3.0 REFERENCES

Office of Environment and Research. 2009. *Tennessee Valley Authority (TVA) Standard Operating Procedure.*

United States Environmental Protection Agency (USEPA). 1991. *Guidance for Performing Preliminary Assessments Under CERCLA. Office of Solid Waste and Emergency Response.* Directive 9345.0-01A, 1991. http://www.epa.gov/superfund/sites/npl/hrsres/#PA%20Guidance.

USEPA. *Region 4, Logbook Operating Procedure.* Document #SESDPROC-010-R3. November 2007.

ATTACHMENT A

FIELD FORMS

EQUIPMENT CALIBRATION REPORT

LITHOLOGY LOG

SOIL SAMPLE COLLECTION LOG

EQUIPMENT CALIBRATION REPORT

Equipment type:	Manufacturer:
Model:	Serial/ID no.:
Calibration standard:	
Purchase/Rental date:	Responsible business unit:
Location:	Calibration frequency:

Initials	Calibration / Bump Test	Result (ppm)	Date	Time	Notes or Comments

Trihydro CORPORATION

Lithology Log Sheet ___ of ___

Project Name: Ash Coulee Incident	Project Number		Site ID	LOCID
Drilling Company	Driller		Ground Elevation	Total Drilled Depth
Drilling Equipment	Drilling Method	Borehole Diameter	Date/Time Drilling Started	Date/Time Total Depth Reached
Type of Sampling Device			Water Level (bgs) First / Final	
Other Driller Information			Hydrogeologist	Checked by/Date
Location Description (include sketch in field logbook)				Sample Analysis

Depth	Interval	Recovery	USCS Group	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, bedding thickness, plasticity, moisture content, and hydrocarbon staining or odor)	Soil Samples: PID (ppm)	Sample ID	Sample Time
5							
10							
15							
20							
25							

Trihydro CORPORATION

Soil Sample Collection Log

Sheet ____of ____

Project Name	Project Number	Project Location	Date
Ash Coulee Incident			

Drilling Company	Driller	Drilling Equipment	Drilling Method

Geologist	Sampling Device	Start Time	End Time	Sample Analysis

Composite Interval (ft bgs)	Recovery (in)	Description (Include lithology, grain size, sorting, angularity, plasticity, moisture content, and hydrocarbon staining or odor)	Soil Samples: PID (ppm)	Soil Samples: Sample ID	Soil Samples: Sample Time

ATTACHMENT B

PHOTOGRAPH LOG

PHOTOGRAPH LOG

Project: Ash Coulee Incident			
Project Location: Billings County, North Dakota			
Photo ID	Date	Direction	Description

Appendix B

memorandum

To:	Belle Fourche Pipeline Company
From:	Trihydro Corporation
Date:	March 4, 2025
Re:	Ash Coulee Incident; Billings County, North Dakota Standard Operating Procedure – Drilling Oversight and Soil Sampling

---

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for overseeing drilling and collecting soil samples via a direct-push drill rig. Coordination with the driller during pre-mobilization preparation is critical to meet sampling objectives of the project.

Prior to sampling, field personnel will ensure the amount, type, and preservation of sample containers selected for the project comply with requirements established in the project-specific Sampling and Analysis Plan (SAP) and/or Quality Assurance Project Plan (QAPP).

Prior to drilling activities, the field geologist will stake the proposed boring locations using a global positioning system (GPS) device pre-loaded with the boring coordinates. Boring activities are segregated into two tasks. Task 1 includes boring locations in the lowland area and Task 2 includes boring locations in the upland area. Proposed boring locations will be assessed for direct-push rig access, ground surface stability, and slope steepness. Of particular concern are the two collection ponds located in the lowland area next to the sheet piling wall. Historically these areas have contained water and crude oil, but in 2024 they were relatively dry. Proposed boring locations in and adjacent to these two collection ponds will provide valuable subsurface information; therefore, additional effort may be required to ensure rig access. This may include the use of timber mats, crushed stone, gravel, or other methods to prevent the rig from sinking into the pond areas. Boring locations will be adjusted in the field, if necessary, to ensure safe operation of the direct-push rig and safety of the drilling crew and field geologist. After boring locations have been pre-marked, North Dakota 811 must be notified by the driller at least 48-hours prior to drilling to obtain utility clearances.

Prior to initiating drilling activities, conduct a bump test of the photo ionization detector (PID) to confirm the reading is within 10% of the calibration gas (100 ppm isobutylene) concentration. If the reading is greater than 10% then perform a calibration of the PID. These steps must be completed at the start and end of each field day. PID bump tests and calibration results will be documented on the equipment calibration report.

Task 1: Lowland Area Soil Logging and Sampling Procedure

For this task 22 borings are proposed in the lowland area as shown on Figure 6-2 of the Work Plan (Geomega 2025). Borings will be advanced with a Geoprobe™ 7782 track mounted rig or similar using a 5-foot macro core sampling device and acetate sleeves to collect each sample core. Borings will be



advanced until the competent clay layer, known as the Sentinel Butte Formation (SBF), is encountered. According to the Geotechnical Data Report (RJH 2024), the contact between surficial colluvium and the SBF is estimated at 6 to 18 feet below ground surface (ft bgs) at the slope toe (lowland area). RJH boring logs note the first occurrence of the SBF as fat (CH) to lean (CL) clays of greenish gray, light gray, and dark gray color with intermittent lenses or seams of lignite. For each boring the following steps will be performed:

1. The driller will advance the macro core sampling device to 5 ft bgs and retrieve the sample core. Do not allow the driller to over-push the sampler, as this results in displaced/missed sample interval and/or over-packing of the sample tool. Use a new pair of nitrile gloves for handling each sample interval.
2. Place the sample core on the vehicle tailgate or folding table and have the drill crew cut open the acetate sleeve lengthwise to expose the sample. Trihydro requires the use of an auto retracting/safety knife and does not allow fixed open-bladed knives for field tasks. Place the sample core on the work surface with a consistent orientation of the sample core top and bottom.
3. Use a folding ruler or tape measure to quantify the total recovery and document lithology, Unified Soil Classification System (USCS) group (e.g., ML, CL, SW, etc.), grain size, sorting, angularity, Munsell soil color, bedding thickness, plasticity, and moisture content on the soil boring lithology log. Note any hydrocarbon staining and/or odor. Photo document each 5-foot core interval.
4. Split the core into two composite samples of 0 to 2.5 ft bgs, and 2.5 to 5 ft bgs. Place soil from each interval into a pre-labeled 1-gallon Ziploc storage or freezer bag with the boring location ID and sample interval depth.
5. Seal the bag and gently knead and shake the bag to mix the soil well. Remove sufficient soil that would fill a lab-provided sample jar (for subsequent analysis) and place the aliquot in a smaller Ziploc bag, confirming there is adequate headspace to measure volatile organic compounds (VOCs). Set the smaller bag aside for 5 to 10 minutes to allow organic constituents to volatilize into the headspace.
6. Screen each composite sample with the PID by unzipping a short section of the bag and inserting the PID tip into the bag without touching the soil. Record the highest PID reading in parts per million (ppm) on the lithology log.
7. With a clean nitrile-gloved hand, transfer soil from the small Ziploc bag into laboratory provided sample jars for analysis of total petroleum hydrocarbons (TPH). Pack sample jars as full as possible to minimize headspace. Label sample jars with the boring ID, depth interval, and sample time and date. Record this same data on the lithology log and Chain-of-Custody (CoC) form. Place each sample jar into a laboratory-provided bubble-wrap bag and then place into an opaque cooler with ice to preserve the sample.
8. For each run the drill crew shall either use a clean core barrel or decontaminate (decon) the macro core barrel with an alconox solution wash, brush, and distilled water rinse. Decon fluids shall be



containerized in 5-gallon buckets or 55-gallon drums for disposal as investigation derived waste (IDW).

9. Repeat Steps 1 through 8, sampling the next interval from 5 to 10 ft bgs with sample intervals from 5 to 7.5 ft bgs and 7.5 to 10 ft bgs. Repeat this process until the SBF or refusal is encountered. Document the top of the SBF in ft bgs on the lithology and photograph log forms. If, for example, a sample core from 10 to 15 ft bgs encounters SBF at 12.5 ft bgs, then only composite the upper core section from 10 to 12.5 ft bgs. Contact the Trihydro Project Manager for clarification, if needed.
10. Containerize remaining soil cuttings in 55-gallon drums for disposal as IDW.
11. Backfill the borehole with bentonite chips to ground surface, then proceed to the next boring and begin at Step 1.
12. Repeat Steps 1 through 12 until Task 1 is completed.

Task 2: Upland Soil Logging and Sampling Procedure

For this task 84 borings are proposed around 10 areas with potential surficial impacts as shown on Figure 6-4 and Figure 6-5 of the Work Plan (Geomega 2025). Borings will be installed in a step-out (spaced 10 ft apart) pattern from each of the 10 areas. Each boring will be advanced with a Geoprobe™ 7782 track mounted rig or similar with a 5-foot macro core sampling device using acetate sleeves to collect each sample core. For each boring the following steps will be performed:

1. The driller will advance the macro core sampling device to 3 ft bgs and retrieve the sample core. Confirm the driller places a mark on the sample core barrel to indicate 3 ft bgs. Do not allow the driller to over-push the sampler, as this results in displaced/missed sample interval and/or over-packing of the sample tool. Use a new pair of nitrile gloves for handling each sample interval.
2. Place the sample core on the vehicle tailgate or folding table and have the drill crew cut open the acetate sleeve lengthwise to expose the sample. Trihydro requires the use of an auto retracting/safety knife and does not allow fixed open-bladed knives for field tasks. Place the sample core on the work surface with a consistent orientation of the sample core top and bottom.
3. Use a folding ruler or tape measure to quantify the total recovery and document the lithology, grain size, sorting, angularity, and plasticity on the soil sample collection log. Note any hydrocarbon staining and/or odor.
4. Take the entire sample core and transfer it into a pre-labeled 1-gallon Ziploc storage or freezer bags with the boring location ID and sample interval depth.
5. Seal the bag and gently knead and shake the bag to mix the soil well. Remove sufficient soil to fill a lab-provided sample jar for subsequent analysis and place the aliquot in a smaller Ziploc bag, confirming there is adequate headspace to measure volatile organic compounds (VOCs). Set the smaller bag aside for 5 to 10 minutes to allow organic constituents to volatilize into the headspace.



6. Screen each composite sample with the PID by unzipping a short section of the bag and inserting the PID tip into the bag without touching the soil. Record the highest PID reading in ppm on the soil sample collection log.
7. With a clean nitrile-gloved hand, transfer soil from the small Ziploc bag into laboratory provided sample jars for analysis of TPH. Pack sample jars as full as possible to minimize headspace. Label sample jars with the boring ID, depth interval, and sample time and date. Record this same data on the soil sample collection log and CoC form. Place each sample jar into a laboratory-provided bubble-wrap bag and then place into an opaque cooler with ice to preserve the sample.
8. For each run the drill crew shall either use a clean core barrel or decon the macro core barrel with an alconox solution wash, brush, and distilled water rinse. Decon fluids shall be containerized in 5-gallon buckets or 55-gallon drums for disposal as IDW.
9. Any remaining soil cuttings will be containerized in 55-gallon drums as IDW.
10. Backfill each boring with bentonite chips to ground surface.
11. Repeat Steps 1 through 10 until Task 2 is completed.

References

Geomega. 2025. Work Plan for the Final Remedial Action at the Belle Fourche Pipeline Company Crude Oil Spill Site Near Bellfield, North Dakota. Geomega, Inc. Boulder, CO. March 7.

RJH Consultants, Inc. 2024. Geotechnical Data Report, Ash Coulee Incident S-316.2. May 2024.

BELLE-024-0002

Appendix C

HEALTH AND SAFETY PLAN

SITE-SPECIFIC EMERGENCY ACTION PLAN

ENVIRONMENTAL ACTIVITIES

BELLE FOURCHE PIPELINE

DICKINSON, ND

January 30, 2025

Project #: BELLE-024-0002

SUBMITTED BY: Trihydro Corporation
1252 Commerce Drive, Laramie, WY 82070

SOLUTIONS YOU CAN COUNT ON.
PEOPLE YOU CAN TRUST.

Home Office | 1252 Commerce Drive | Laramie, WY 82070 | p. 307/745.7474 | f. 307/745.7729 | trihydro.com

memorandum

To:	Project Team Members
From:	Ms. Kathy Brown
Date:	January 30, 2025
Re:	Bell Fourche Pipeline Company Emergency Action Plan

INTRODUCTION

Belle Fourche Pipeline (BFPC) is a subsidiary of True Companies. They have been a client of Trihydro for over 25 years.

PROJECT/SITE HISTORY

A pipeline leak was discovered on December 5, 2016 approximately 30 miles north of Belfield, ND. The spill occurred on a hillside and flowed downhill and into a tributary of Ash Coulee Creek. BFPC staff and EPA Region 8 oversaw initial emergency response activities. BFPC contracted Trihydro to assist with hillside regrading, investigation, and remediation design and implementation.

WORK SCOPE

Trihydro is implementing ongoing assessment and remedial activities at the Site.

MINIMUM/ANTICIPATED PERSONAL PROTECTIVE EQUIPMENT (PPE) AND EQUIPMENT

The minimum PPE required for the project, and anticipated PPE based on tasks scheduled and environmental conditions, include:

- Steel-toed boots
- Hardhat
- Safety glasses
- FRCs

TRAINING/DRUG SCREENING REQUIREMENTS

This facility requires an initial on-site safety training and an annual refresher thereafter. In accordance with the Trihydro Substance Abuse Testing Program, at no time while on duty may employees use or be under the influence of alcohol, narcotics, intoxicants, or similar mind-altering substances to include prescription medications. Employees found under the influence or consumption of substances are to be immediately removed from the jobsite. Trihydro reserves the right to test for substance abuse. As part of implementing Trihydro's program to deter alcohol, drug, and substance abuse, each employee may be requested to submit to urine, blood, or other medical tests at any time, with or without notice. Employees are further subject to "for cause" drug, alcohol, or substances testing. "Cause" is determined if the company has reason to believe that the covered



worker has used alcohol or illegal drugs or has misused prescription medication or over-the-counter drugs. Key reasons for testing may include the following: accidents, injuries, near misses, excessive absences, tardiness, altercations, lengthy absences, possession of drugs, or thefts. This policy applies to Trihydro employees and subcontractors.

Drug Testing Facilities

Preble Medical Services, Inc. - Dickinson	401 W Villard Ste 201	Dickinson, ND	(701) 225-9040
B&H On-Site Testing	1674 15th Street West Ste 201	Dickinson, ND	(701) 690-0585
Badlands Integrity Group	366 21st Street East	Dickinson, ND	(701) 483-6559

OTHER HEALTH AND SAFETY CONCERNS

Sensitive landowner, lease roads (gravel and dirt), snakes, spiders, mosquitos, and ticks.

MOBILE PHONE AND ELECTRONIC DEVICES SAFETY

A mobile phone is defined as a cellular phone, a mobile telephone, or a similar electronic communication device (including global positioning devices [GPS]) that facilitates both simplex (push-to-talk) and duplex (multi-directional simultaneous conversations) functions. Example activities include voice communication, text messaging, electronic mail, and other operations requiring active manipulation of the device, including operation of the devices in hands-free or hand-held modes. For the purposes of this standard, two-way radios that are only capable of simplex communication (push-to-talk) are excluded from the definition of mobile phones.

The following are specifically prohibited:

- Use of mobile phones by drivers while operating a company vehicle on public roadways.
- Use of mobile phones by drivers while operating a personal vehicle on company business.
- Use of mobile phones by drivers while operating a motor vehicle on company business, unless allowable areas and circumstances are designated by applicable work site rules and instructions (such as areas restricted from public access inside an operating facility or controlled area).

BELLE-024-0002

HASP REVIEW PROCESS

This document has been developed by the corporate Health and Safety Department followed by peer review in accordance with the Trihydro Corporation Writing-Style Manual policy by the project management and an authorized final reviewer on behalf of the Health and Safety Department.

Health and Safety:

Todd Forry		01/24/2025
Reviewer's Name	Reviewer's Signature	Date

Project Manager:

Kathy Brown		1/28/2025
Final Reviewer's Name	Final Reviewer's Signature	Date

PRE-ENTRY BRIEFING ACKNOWLEDGEMENT

I certify that I have read and understand the contents of this Health and Safety Plan (HASP), Belle Fourche Pipeline, Dickinson, ND and reviewed appropriate Job Safety Analysis (JSA) forms, Belle Fourche Pipeline-specific safety documents, and Trihydro Corporation safety policies, procedures, plans, and documents for hazards that may be encountered on this project. Check the reason block if this is for initial entry or because of a change in the HASP or to recognized hazards.

Name/Signature	Reason	Date
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1.0 EMERGENCY RESPONSE PLAN

Because of the distance from the nearest medical assistance (more than 3-4 minute response), this project requires training and assigned project personnel to provide first aid.

The following personnel are trained in CPR and first aid:

Trent Foky	Dusty Myrup
DJ Creek	Nate Dodge
Kyle McDonald	

Emergency response will be carried out immediately whenever there is a personal injury, fire, or explosion. Field team members who sight or suspect a fire, explosion, or other potential risk to employees or environmental health will notify the Trihydro Corporation (Trihydro) Project Manager (PM) immediately. A first-aid kit and fire extinguisher will be maintained for the project.

Trihydro employees will be familiar with emergency procedures for the project. Project emergency procedures will be reviewed with the team members during the morning kick-off safety meeting. Project workers will be instructed to immediately shut down activities when a hazard is discovered.

A primary line of communication with emergency services will be established prior to work commencement. A secondary form is highly encouraged. Forms of communication include, but are not limited to, landline telephone, cellular telephone with verified acceptable signal strength, and two-way radios.

The following information is provided in the event of an emergency.

1.1 PROJECT EVACUATION PROCEDURES

Project Alarms ☒ N/A

Type	*Description*
☐ Fire	
☐ Chemical Release	
☐ Evacuation	
☐ Severe Weather	
☐ All Clear	
☐ Other	

Project Evacuation Routes

Primary	Up/cross wind from hazard, as discussed in the daily tailgate meeting.
Alternate	Up/cross wind from hazard, as discussed in the daily tailgate meeting.

Project Assembly Areas

Primary	As discussed in the daily tailgate meeting.
Alternate	Fleet vehicle, as discussed in the daily tailgate meeting.

1.2 EMERGENCY CONTACT LIST

Local Emergency Services

Police Emergency/Station 911/ (701) 456-7759
Fire Department Emergency/Station 911/ (701) 456-7625
Ambulance Emergency/Station 911/ (701) 225-1500
Hospital, **CHI St. Alexius Health Dickinson** ..... (701) 456-4000
ND Highway Patrol 701-328-2447
Poison Control ..... (800) 222-1222
Call Before You Dig 811
WorkCare™ Incident Intervention (24-hours) ..... (888) 449-7787

Company Contacts

Project Manager (PM)**, Kathy Brown** ..... (307) 349-3334
Project Site Health & Safety Officer (PSHSO), **Kathy Brown** ..... (307) 349-3334
Risk Management (after hours) ..... (307) 760-1849
Safety Coordinator (after hours) ..... (307) 760-8269
Safety Response Line (24/7) ..... (307) 755-4888
Safety FAX ..... (307) 460-7428

Federal/Government Contacts

Environmental Protection Agency (EPA) Hotline (Region 8) ..... (800) 227-8917
National Institute of Occupational Safety and Health (NIOSH) Hotline ..... (800) 232-4636
Occupational Safety and Health Administration (OSHA) ..... (202) 219-8148
OSHA Hotline ..... (800) 321-6742
National Response Center (report spills and chemical releases) ..... (800) 424-8802
CHEMTREC (24-hour Hazardous Materials Communications Center) ..... (800) 262-8200
ChemTel (for hazardous materials information) ..... (800) 255-3924
Department of Transportation (DOT) Safety Administration ..... (888) 327-4236

1.3 EMERGENCY MEDICAL CARE

The primary concern during emergencies is the medical treatment of injured or exposed personnel. It is crucial that employees understand the contents of the Health and Safety Plan's (HASP's) Emergency Response Plan to include the location of emergency contact numbers, the route to the nearest hospital, and the process of using WorkCare™, Trihydro's contracted medical intervention provider.

- PM needs to print the emergency contact list and provide to project workers (if available).
- PM needs to print hospital routes and provide to project workers (if available).
- Team members need to have their WorkCare™ contact cards available.
- When present, the PM, or other Trihydro representative, needs to accompany the injured employee to the hospital.
- WorkCare™ needs to be contacted so as to provide the treating facility with the injured employee's medical records and to coordinate medical treatment.

A map showing the location of the nearest hospital is shown on **Figure 1-1**.

1.4 NON-EMERGENCY MEDICAL CARE

The health and welfare of the project team members is a primary concern; thus, employees must understand the procedures for contacting WorkCare™ for non-emergency medical situations. To provide the best care of staff, contact WorkCare™ to provide information for the nearest occupational health clinic, or use the services provided by the hospital listed in this HASP.

- Team members need to have their WorkCare™ contact cards available.
- When present, the PM, or other Trihydro representative, needs to accompany the employee to the clinic.
- WorkCare™ needs to be contacted to provide the treating facility with the employee's medical records and to coordinate medical treatment.

1.5 INCIDENT AND ACCIDENT REPORTING

Trihydro employees will report, in writing, to Trihydro's Corporate Health and Safety (H&S) Office, incidents or near misses resulting in personal or public injury, environmental impact, or property damage to the client-operated site, materials, or equipment, including motor vehicles owned by Trihydro, its subcontractors, or the client. Regarding accidents, incidents, or near misses, verbal reports will be made within 24 hours, followed by written reports to the client PM through Trihydro's PM or Director. A copy of the "Near Miss Report" form can be found on the H&S

Forms Web site, and the data entered into Trihydro's Safety Performance Observation Tracking (SPOT) system. A near miss is an event, given a change in time or position, that could have resulted in an incident.

Report incidents, accidents, and near misses as follows:

- Immediately report the near miss or incident to the Trihydro PSHSO
- Immediately report the near miss or incident to the Trihydro PM or Director
- Immediately report incidents by phone to the client PM
- Within 24 hours, report near misses to the client PM
- Within 5 business days, enter near misses and incidents into the client's reporting database

Examples of incidents and near misses to be reported are as follows:

- Environment (e.g., spills, releases, odor complaints, permit exceedances, process upsets)
- Injury/illness (e.g., injuries, illnesses, first aid, recordables, lost workday cases, fatalities, non-injuries)
- Property damage/loss (e.g., fires, explosions, loss of well control, business interruptions, abnormal operations, production loss/reduction)
- Security (e.g., vandalism, burglaries, break and enters, robberies, theft, public disturbances, trespasses)
- Vehicular accidents (e.g., cars/pickups/trucks, barges/boats/ships, aircraft, rail cars, tankers/transports, cranes/fork trucks)

Incident and accident reporting is important for many reasons to help improve the H&S program; without these reports, unsafe conditions could continue to exist exposing employees unnecessarily.

Incident and accident reports will be prepared immediately after the event occurs. This is necessary to verify that important evidence is not lost or disturbed and details are not forgotten by those involved. The "Accident/Incident Investigation Report" form can be found on the H&S Forms Web site, and the data entered into SPOT.

1.6 INCIDENT RESPONSE

1.6.1 VEHICLE ACCIDENT

- Provide immediate care for personnel, safety, and vehicle security
- Initial notification
  - Notify police/ambulance (911)
  - Notify the Trihydro H&S using the Safety Response Line (307) 755-4888
  - Notify the PM
  - Notify the supervisor
  - Notify the client as directed by the PM
  - Notify the rental car agency as directed by the PM (if applicable)
- If medical treatment is required, notify WorkCare™ (888) 449-7787
- Complete drug and alcohol testing as soon as possible (within 3 hours); coordinate with H&S Department
- Complete and file reports within 12 hours

1.6.2 INCIDENT

- Stop work and provide immediate care for personnel, safety, and site security
- Initial notification
  - Notify police/ambulance (911), if applicable
  - Notify the Trihydro H&S using the Safety Response Line (307) 755-4888
  - Notify the PM
  - Notify the supervisor
  - Notify the client as directed by the PM
  - Notify site managers as directed by the PM
- If medical treatment is required, notify WorkCare™ (888) 449-7787
- Complete and file written reports within 12 hours
- Before returning to work:

- Notify the PM and supervisor
- Assess and analyze the conditions for safety
- Take applicable corrective actions to prevent recurrence

1.7 HOSPITAL ROUTES

The primary hospital route from the project site can be found on the following pages.

FIGURE 1-1. PRIMARY HOSPITAL ROUTE



Directions to Hospital

Hospital Name: **CHI St. Alexius Health Dickinson**

Address: **2500 Fairway St, Dickinson, ND 58601**

Telephone Number: **(701) 456-4000**

Summary

Driving distance: 40.43 miles

Trip duration: 46 minutes

Instruction	For
Depart site (-103.369 47.10544). go Southeast	0.93 mi
Turn LEFT	0.35 mi
Turn LEFT	0.08 mi
Turn RIGHT on **Ash Coulee Rd 21st St SW**	0.76 mi
Turn RIGHT on **134th Ave SW**	1.99 mi
Continue forward on **S Ash Coulee Rd 133rd Ave SW**	1.67 mi
Continue forward on **133rd Ave SW**	0.37 mi
Continue forward on **S Ash Coulee Rd**	5.32 mi
Turn RIGHT on **Highway 85 SW US-85N**	11.03 mi
Turn LEFT to merge onto **I-94 E** toward Bismark	16.89 mi
Take **Exit 59** on the RIGHT toward **I-94BL E**	0.26 mi
At the stop sign, turn RIGHT on **30th Ave W**	0.37 mi
Turn LEFT on **Fairway St**	0.30 mi
Make a U-turn and go back on **Fairway St**	0.10 mi
Arrive CHI St. Alexius Health Dept. ER on the RIGHT	

FIGURE 1-2. PRIMARY HOSPITAL ROUTE START POINT

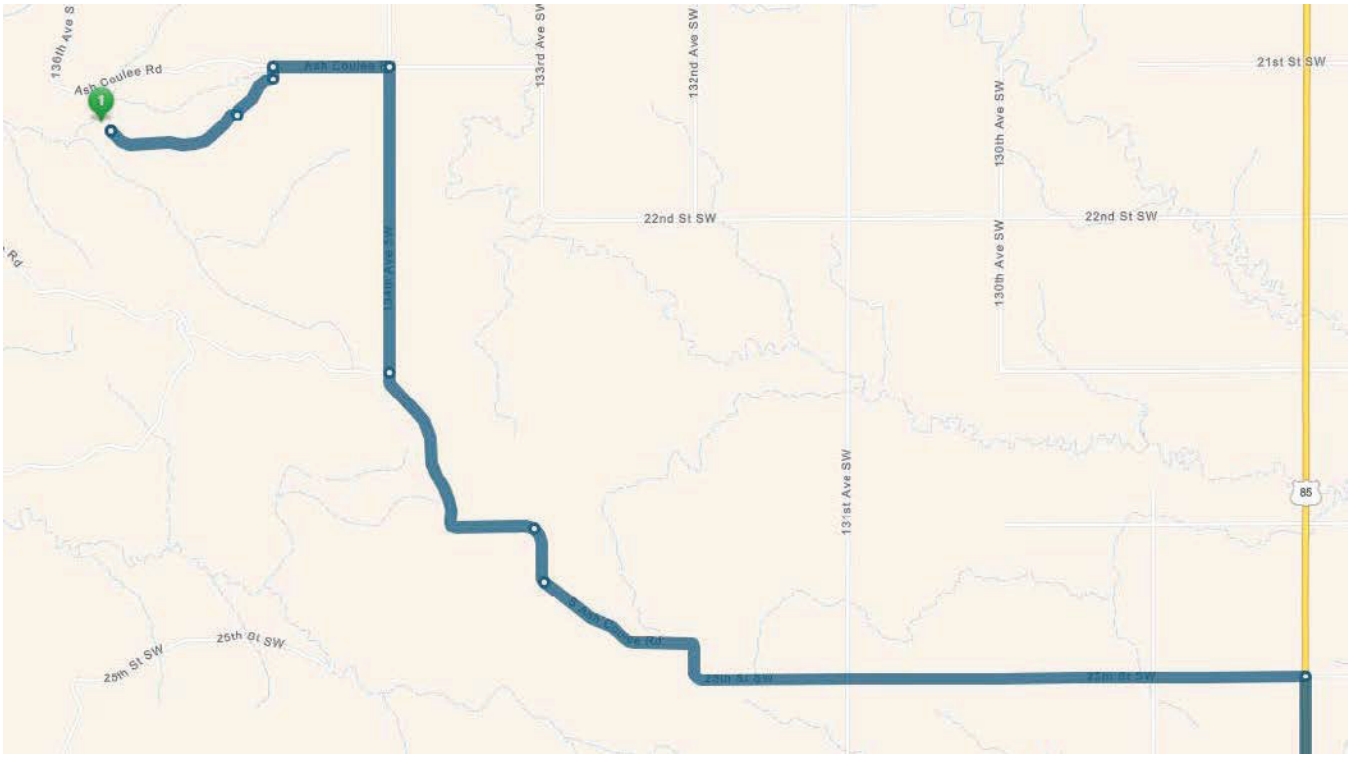
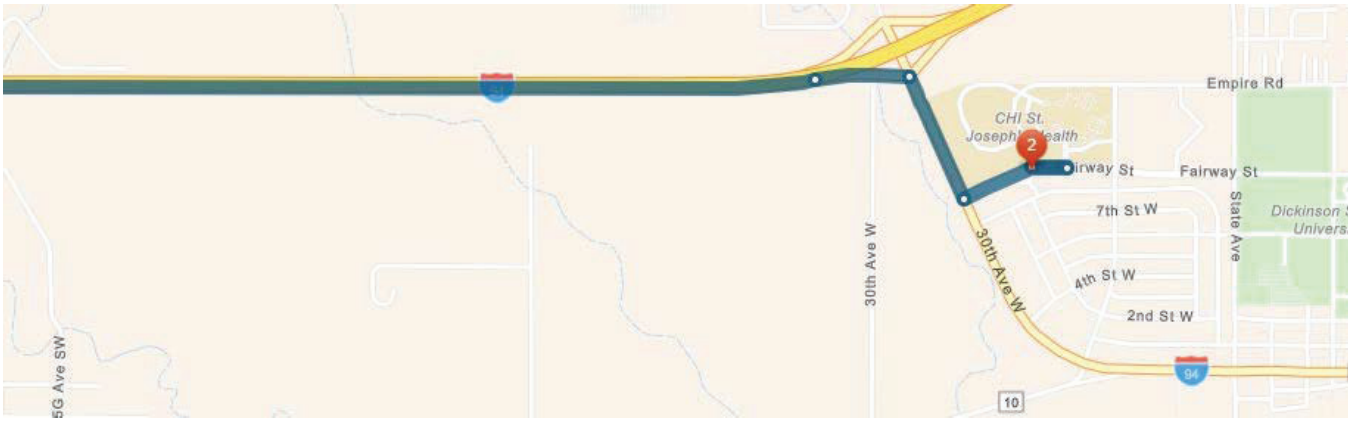


FIGURE 1-3. PRIMARY HOSPITAL ROUTE END POINT



2.0 PERSONNEL RESPONSIBILITIES

2.1 PROJECT TEAM RESPONSIBILITIES

Project personnel responsible for the oversight of this project are:

Position	Name
Project Director	George Mathes
Project Manager (PM)	Kathy Brown
Project Site Health and Safety Officer (PSHSO)*	Kathy Brown and/or designee
Trihydro Team Members	Trent Foky
	DJ Creek
	Kyle McDonald
	Allie Wolverton
	Nate Dodge
	Dusty Myrup

*The PSHSO is present at the project site.

The responsibilities of each group of personnel are listed below. It is the responsibility of the PM to verify that the field team has access to this HASP and supportive documentation, and reads the safety procedures. It is the individual's responsibility to bring to the attention of the PM or the Corporate H&S Manager portions of this HASP and related training that he/she does not fully understand.

Project employees and subcontractors will conduct safety meetings at appropriate intervals to verify that personnel are fully informed of potential hazards. Attendance at safety meetings is to be documented, and personnel must sign attendance sheets. The attendance sheets will be retained by Trihydro and made available to the appropriate client representative on request. Trihydro's "Daily Tailgate Safety Meeting."

2.2 ADHERENCE TO POLICY

The Belle Fourche Pipeline project policies and procedures can be request from the Trihydro Project Manager and are those applicable to the work of Trihydro and its subcontractors. The more restrictive and protective project policies and procedures and safe work practices, whether Belle Fourche Pipeline, Trihydro, or subcontractor, supersede and take precedence over similar practices discussed in Trihydro Project and Corporate HASPs or subcontractor safety procedures. Trihydro and Trihydro subcontractor personnel who perform field services at the project must read, understand, and comply with these policies and procedures.

2.2.1 PROJECT MEMBERS

Trihydro is a strong advocate for Behavior-Based Safety (BBS), where the "one team" approach to safety is highly supported. Project members, including subcontractors, are expected to perform Work Site Self-Assessments; conduct task observations; exercise the right to refuse unsafe work and initiate Stop Work Authority; review Job Safety Analysis (JSA) forms; review Safety Data Sheets (SDSs)**;** and report unsafe conditions—all to promote the highest level of safety.

2.2.2 TRIHYDRO PROJECT DIRECTOR

The responsibilities of the Project Director with respect to safety are as follows:

- Verify that Trihydro field team personnel have read and understand this HASP
- Make available to the field team personnel the data known to him/her on this project

2.2.3 TRIHYDRO PROJECT MANAGER (PM)

The responsibilities of the PM with respect to safety are as follows:

- Verify acceptable cellular reception at site
- Verify route from site to hospital by driving the published route
- Coordinate initial project safety training for project team personnel as described in this document
- Verify that field team personnel have read and understand this HASP
- Verify that Trihydro field team personnel have the required materials needed before the start date in order to meet the requirements of this specific project HASP
- Make available to the field team personnel and the appropriate client representative H&S information relevant to this project

2.2.4 TRIHYDRO PROJECT SITE MANAGER

The responsibilities of the Project Site Manager with respect to safety are as follows:

- Verify acceptable cellular reception at site before work commencement
- Verify that there are no route obstructions (i.e., construction) from the site to the hospital
- Conduct daily safety briefing
- Coordinate efforts and communicate site tasks with other project contractors
- Establish communications among other project contractors via phone or radio to enhance coordination in the event of an emergency

2.2.5 TRIHYDRO PROJECT SITE HEALTH AND SAFETY OFFICER (PSHSO)

The responsibilities of the Trihydro PSHSO with respect to safety are as follows:

- Verify that work performed by Trihydro is conducted in accordance with safe practices outlined in this HASP.
- Communicate to workers what is expected of them.
- Note weather conditions.
- Identify and schedule training.
- Calibrate air and personal monitoring equipment.
- Identify and remove hazards where possible.
- Monitor activities for the proper use of personal protective equipment (PPE) specified in this HASP, such as respirators with appropriate filters and/or canisters, protective coveralls, gloves, safety boots, protective eyewear, ear plugs, and hard hats.
- Make PPE equipment available.
- Monitor PPE usage, storage, maintenance, and replace when necessary.
- Verify that safety equipment to be used by field team personnel is maintained and in a usable condition.
- Use safe work practices.
- Initiate emergency phone calls when an emergency or accident requires medical attention.
- Correct unsafe conditions and behaviors immediately.
- Conduct additional H&S meetings deemed necessary.
- Report problems to the PM.

2.2.6 TRIHYDRO FIELD TEAM MEMBERS

The responsibilities of the Trihydro Field Team Members with respect to safety are as follows:

- Become thoroughly familiar with this HASP and its supportive documentation.
- Actively participate in this project HASP.
- Follow safety standards and safe work practices set out by Trihydro, the client, and regulatory agencies.
- Refuse to perform work when unsafe conditions exist.
- Report potential hazards to the PSHSO.
- Immediately report potential hazards, accidents, incidents, injuries, and illnesses to the PSHSO.
- Inform PM of contact lens use.
- Inform PM if allergic to insect stings/bites or other biological hazards.
- Inform the Trihydro Risk Management Office's Health Insurance Portability and Accountability Act (HIPAA) Officer if taking medication that can impair physical and/or cognitive abilities to perform duties.
- Use PPE when needed.
- Inspect PPE and safety equipment before use.
- Have required equipment operating permits on person.
- Be familiar with the location, type, and operation of project and facility emergency equipment and procedures.

2.2.7 SUBCONTRACTOR TEAM MEMBERS

The responsibilities of the Subcontractor Team Members with respect to safety are as follows:

- Perform work safely.
- Read and understand subcontractor HASPs.
- Adhere to applicable HASP protocol.
- Provide applicable H&S monitoring.
- Report unsafe acts to Trihydro's PSHSO.
- Properly inspect and maintain heavy equipment and other machines in compliance with applicable sections of the federal and state Occupational H&S Codes.

- Supply and maintain safety-related protective equipment specified in this HASP, such as respirators with appropriate filters and/or canisters, protective coveralls, gloves, safety boots, protective eyewear, ear plugs, and hard hats.
- Enforce corrective action in cooperation with the client and Trihydro's PSHSO.
- Inform Trihydro's PSHSO of the presence of potential health or safety hazards.
- Be aware and alert for signs and symptoms of potential exposure to project contaminants and climatic or acoustic stress.
- Inspect PPE and safety equipment prior to use.
- Inform PM of contact lens use.
- Inform the PM if allergic to insect stings/bites or other biological hazards.
- Inform their subcontractor company HIPAA Officer if on medication that can impair physical and/or cognitive abilities to perform duties.
- Have required equipment operating permits on person.
- Be familiar with the location, type, and operation of project and facility emergency equipment and procedures.

2.3 SAFE WORK PRACTICES

The following section presents procedures on how to address the hazards expected to be encountered during site activities for this project. During times when site operations are under the observation of a Trihydro representative, Trihydro will notify contractor personnel on site and a client representative if an unsafe condition is observed.

2.3.1 STOP WORK AUTHORITY PROGRAM

Employees not only have the right to refuse unsafe work, they also have the right to stop unsafe practices of others. The stop work authority program gives any employee working onsite the ability to stop all work related to a specific activity being performed in a manner in which there is an imminent danger to personnel, property, or the environment. All employees and contractors are responsible for participating in the stop work authority program.

The stop work order is binding until either the employee who stopped the work or the site PM rescinds the order. The site PM is the only individual who can overrule the employee who initially stopped the work.

NOTE: The requirements and responsibilities identified in the stop work authority program may cross company boundaries. For example, a Trihydro employee may identify a subcontractor performing an unsafe act or creating an unsafe condition and stop the work, or vice versa. Any unsafe act or condition identified must be investigated and corrected by either the employee who stopped the work or the site PM.

Any employee who identifies an unsafe act or condition that warrants a stop work order shall immediately conduct the following:

- Notify affected employees (includes workers in the general area)
- Take the appropriate actions necessary to protect workers, the public, the environment, and the property
- Notify immediate supervisor
- Notify site PM if different from immediate supervisor

Affected employees will immediately comply with the stop work order until either the employee who stopped the work or the site PM rescinds the order.

Every stop work order will be investigated and corrected as soon as possible. Individuals involved in the investigation will be determined by the site PM. The results of the investigation shall be communicated to all affected employees including the employee who initially stopped the work and the site PM.

No employee will receive any kind of reprisal, retribution, or discipline for exercising a stop work authority.

2.3.2 HAND INJURY PREVENTION

Employees are expected to assess their tasks for physical, chemical, and thermal hand hazards and implement engineering and administrative controls, and PPE, or a combination of the three.

2.3.2.1 ENGINEERING CONTROLS

Engineering controls prevent the physical placement of the employee's hand in harm's way. An example is machine guarding to protect from hazards such as those created by point of operation (area on a machine where work is actually performed), ingoing nip points, rotating parts, flying chips, and sparks.

2.3.2.2 ADMINISTRATIVE CONTROLS

Administrative controls are designed to make an individual aware of the hazard and, therefore, limit their exposure. Administrative controls may include training, labeling, signs, and safe work practices and procedures.

2.3.2.3 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Gloves can protect against chemical exposure, lacerations, and thermal hazards. However, employees need to understand that one type of glove does not protect against all hazards. Employees need to match the right glove material with each application or task. This includes assessing the job for chemical exposures, pinch points, laceration hazards, thermal risks, abrasion exposure, puncture risks, and then selecting the appropriate glove based on material, thickness, length, and other traits. Clients may have strict guidelines for proper glove selection, so get with your PM for more details.

Warning: Loose fitting clothing, including loose fitting gloves and unbuttoned sleeve cuffs, must not be worn around rotating or moving equipment such as, but not limited to, power transmission shafts, pulleys, feed rolls, drill presses, power augers, and rotating stock!

Here is a table to provide glove-selection guidance:

Protection	Glove Material	Applications
Lacerations	Dyneema®, Kevlar®, fiber-metal blends, metal mesh, SuperFabric®, steel core, and Vectran	Cut-resistance: designed to protect hands from direct or indirect contact with sharp edges such as glass, metal, ceramics, and other materials. Many cut resistant gloves are manufactured to provide protection from a *SLASH* from sharp items like knives/blades. However, they may provide very little, if any, puncture-resistance from a pointed item like a needle, unless specifically designed for puncture resistance.
Needle Stick	HEX ARMOR®, DAMASCUS V-Force™ X4	Puncture protection. Ideal for correctional facility pat-downs/searches, customs officers, federal/state/city/municipal/university employees, luggage searches, hospital laundry and sharps handling.
Vibrations	DECADE® Gelfom™, AirGlove™	Provides padding at the palm, fingers and thumb to help neutralize the force of heavy impacts, reducing the chance of injury.

Protection	Glove Material	Applications
Extreme high temperatures	Best® CharGuard™, ZETEX®, Kevlar®, Nomex®, Crusader Flex®, thermal knit, Terry Cloth, heavy weight cotton	For intermittent handling of hot objects. Ideal for hot castings for intermittent heat, lab sampling with hot glassware or moldings, plastic molding manufacturing, plant maintenance controls. Temperature protection ranges vary.
Extreme low temperatures	Best® Snow Man™, thermal knit, Terry Cloth, heavy weight cotton	For intermittent handling of hot objects.
Chemical	Butyl	A synthetic rubber material that offers the highest permeation resistance to gas and water vapors. Especially suited for use with esters and ketones.
	Neoprene	A synthetic rubber material that provides excellent tensile strength and heat resistance. Neoprene is compatible with some acids and caustics. It has moderate abrasion resistance.
	Nitrile	A synthetic rubber material that offers chemical and abrasion resistance—a very good general-duty glove. Nitrile also provides protection from oils, greases, petroleum products and some acids and caustics.
	PVC (Polyvinyl chloride)	A synthetic thermoplastic polymer that provides excellent resistance to most acids, fats, and petroleum hydrocarbons. Good abrasion resistance.
	PVA (Polyvinyl alcohol)	A water-soluble synthetic material that is highly impermeable to gases. Excellent chemical resistance to aromatic and chlorinated solvents. This glove cannot be used in water or water-based solutions.
	Viton®	A fluoroelastomer material that provides exceptional chemical resistance to chlorinated and aromatic solvents. Viton is very flexible, but has minimal resistance to cuts and abrasions.
	SilverShield®/4H	A lightweight, flexible laminated material that resists permeation from a wide range of toxic and hazardous chemicals. It offers the highest level of overall chemical resistance, but has virtually no cut resistance.

Appendix D

MASTER HEALTH AND SAFETY PLAN

TRUE COMPANIES

ENVIRONMENTAL ACTIVITIES

COLORADO, MONTANA, NORTH DAKOTA, PENNSYLVANIA, UTAH AND WYOMING

January 2025

SUBMITTED BY: Trihydro Corporation

1252 Commerce Drive, Laramie, WY 82070

SOLUTIONS YOU CAN COUNT ON.
PEOPLE YOU CAN TRUST.

Home Office | 1252 Commerce Drive | Laramie, WY 82070 | p. 307/745.7474 | f. 307/745.7729 | trihydro.com

HASP REVIEW PROCESS

This document has been developed by the Corporate Health and Safety Team followed by peer review in accordance with the Trihydro Corporation (Trihydro) Writing-Style Manual (WSM) policy by the project management and an authorized final reviewer on behalf of the Health and Safety Team.

Health and Safety:

Todd Forry		01/24/2025
Reviewer's Name	Reviewer's Signature	Date

Project Manager:

Kathy Brown		01/28/2025
Final Reviewer's Name	Final Reviewer's Signature	Date

PRE-ENTRY BRIEFING ACKNOWLEDGEMENT

Trihydro

I certify that I have read and understand the contents of this Health and Safety Plan (HASP), Environmental Activities, True Companies, and reviewed appropriate Job Safety Analysis (JSA) forms, Trihydro safety policies, procedures, plans, and documents for hazards that may be encountered on this project. Check the reason block if this is for initial entry, because of a change in the HASP, or to recognized hazards as outlined in Section 7 of this HASP.

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Pre-Entry Briefing Acknowledgement (continued)

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1.0 INTRODUCTION

1.1 REFERENCES

The 29 Code of Federal Regulations (CFR) 1910 General Industry standards, 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER), will dictate the primary information contained within this HASP where section 1910.120(b)(1)(ii)(C) states that "a site-specific safety and health plan which need not repeat the employer's standard operating procedures required in paragraph (b)(1)(ii)(F)" and will contain the elements listed under 1910.120(b)(4)(ii).

The following states have approved state OSHA plans. PMs need to be familiar with the state plans that apply to their project sites and understand the more restrictive standards to stay in compliance:

- Alaska
- Arizona
- California
- Connecticut
- Hawaii
- Illinois
- Indiana
- Iowa
- Kentucky
- Maryland
- Michigan
- Minnesota
- Nevada
- New Jersey
- New Mexico
- New York
- North Carolina
- Oregon
- Puerto Rico
- South Carolina
- Tennessee
- Utah
- Vermont
- Virgin Islands
- Virginia
- Washington
- Wyoming

Note: The Connecticut, Illinois, New Jersey, New York, and Virgin Islands plans cover public sector (State & local government) employment only.

1.2 APPLICATION

This Master HASP applies to the sites specified in the EAPs and those tasks and operations identified in Section 2.0.

1.3 PURPOSE

The purpose of this Master HASP and associated EAPs is to provide Trihydro employees with emergency response information, high-level hazard analyses, and a summary of safe work requirements. Subcontractors may wish to use Trihydro's plan as a guideline. However, subcontractors will have their own health and safety plan (HASP) developed by their respective companies. The primary responsibility for employee safety lies with each company for its own employees.

1.4 REQUIRED DOCUMENTATION

Project work will comply with applicable sections of the Occupational Safety and Health Administration (OSHA), state, Trihydro, and client standards, policies, procedures, and plans. The more stringent standards will apply. This HASP and supportive documentation will be kept on site in accordance with 29 CFR 1910.120(b)(4)(i).

This Master HASP, EAPs and supportive documentation will be kept on site in accordance with 29 CFR 1910.120(b)(4)(i).

Trihydro employees and subcontractors that are covered by contractual agreements with Trihydro performing tasks outlined in this Master HASP need to have a thorough understanding of supportive documentation. The following documents will accompany this Master HASP as supportive documentation:

- Near Miss Report and Accident/Incident Investigation Report. See **Appendix A and B.**
- Job Safety Analysis (JSA) oriented to the site tasks and operations outlined in this HASP. See **Appendix C**.
- Safety Data Sheets (SDSs). See **Appendix D**.
- Client-specific health and safety policies, procedures, or plans relevant to the tasks outlined in this HASP. **See site-specific EAPs.**

1.4.1 JOB SAFETY ANALYSIS (JSA)

JSA forms are living documents to assist in hazard awareness and in task preparation. Employees are expected to review JSA forms before work commencement, have the JSA at the task site, and revise the JSA when discrepancies are noted. The following JSA forms are included in **Appendix C**:

☐ Air Knife Borehole Clearance	☐ Forklift Operations	☒ Sample Pres/Bottle Prep
☐ Air/Knife/Vacuum Extraction	☒ Fueling Vehicles	☐ SUMMA Canister Sampling
☐ Asbestos ID and Burial	☐ Geoprobe/Geopunch Sampling	☐ Surface Water Sampling
☐ Asphalt Placement Observation	☒ GPS Surveying	☒ TVA 1000 Calibration
☐ Boating	☒ Groundwater Gauging	☒ TVA 2020 Fill Hydrogen Tank
☐ Confined Space Entry	☒ Groundwater Sampling	☒ Vehicle Operation
☒ Contaminated Soil Cleanup	☒ H_2S Awareness	☐ Voltage and Ground Test
☒ Contractor Oversight	☒ Instrument Maintenance	☒ Well Abandonment
☐ Drilling	☐ Hydraulic Direct Push Sampler	☒ Well Gauging
☒ Drilling Oversight	☐ Hydroknifing	☒ Well Installation
☐ Dump Truck Loading	☒ LDAR Monitoring	☐ Well Rehabilitation
☐ Dump Truck Operations	☒ Packing Samples for Shipment	☐ Well Replacement
☒ Excavation Observation	☒ Other: Difficult to Monitor	
☐ Flume Sampling	☒ Other: OGI Survey	

1.4.2 SAFETY DATA SHEETS (SDSS)

The following SDSs are included in **Appendix D**:

- ☐ Acetone
- ☐ Acrylonitrile
- ☒ Alconox
- ☐ Aniline
- ☐ Aromatic 100
- ☐ Aromatic 150
- ☒ Asbestos
- ☒ Bentonite
- ☐ Benzene
- ☐ BTEX Calibration Gas
- ☐ Cadmium
- ☐ Celtone
- ☐ Chrome
- ☐ Coal
- ☐ Coal Fly Ash
- ☐ Coke
- ☐ Condensate
- ☒ Crude Oil
- ☐ Dichloroethane
- ☐ Diesel Fuel
- ☐ Dimethyl Sulfide
- ☐ DIPE
- ☐ Ethanol
- ☐ Ethyl Benzene
- ☐ Fly/Coal Ash
- ☐ Fuel Oil
- ☐ Gasoline
- ☐ Granite Rock Dust
- ☐ Grease
- ☐ Heptane
- ☐ Hexane
- ☐ Hexanone
- ☐ Hydraulic Oil/Fluid
- ☐ Hydrocarbons
- ☒ Hydrochloric Acid
- ☐ Hydrofluoric Acid
- ☐ Hydrogen
- ☒ Hydrogen, Compressed
- ☐ Hydrogen Chloride
- ☒ Hydrogen Sulfide
- ☐ Isobutane
- ☒ Isobutylene
- ☐ Isopropyl Alcohol
- ☐ Kerosene
- ☐ Lead
- ☐ Lead Acid (Battery)
- ☐ Methane
- ☒ Methane, Compressed
- ☒ Methanol
- ☐ Methyl Methacrylate
- ☐ Methyl Propyl Ketone
- ☐ Methylene Chloride
- ☐ Methyl Isobutyl Ketone
- ☐ Mineral Spirits
- ☐ Motor Oil
- ☐ MTBE
- ☒ Natural Gas Condensate
- ☒ Natural Gas Liquid
- ☒ Nitric Acid
- ☐ Nitrogen, Liquid
- ☐ Oxygen, Compressed
- ☐ Perchloric Acid
- ☐ Phosphoric Acid
- ☐ Phthalic Anhydride
- ☐ Propane
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____
- ☐ Selexol
- ☒ Simple Green
- ☐ S-K 105 Solvent
- ☐ Sodium Hydroxide
- ☐ Sodium Nitrate
- ☐ Sodium Phosphate Monobasic
- ☐ Sulfuric Acid
- ☐ Surflan
- ☐ Survey Marker Paint
- ☐ Tack
- ☐ Tetrahydrofurane
- ☐ Toluene
- ☐ Trichloroethane
- ☐ Triethylamine
- ☐ Trimethyl Benzene
- ☐ Used Oil
- ☐ Vinyl Chloride
- ☐ Xylene

1.5 TRAINING REQUIREMENTS

Trihydro employees and subcontractors that are covered by contractual agreements with Trihydro performing tasks outlined in this Master HASP need to meet the training requirements outlined in OSHA 29 CFR 1910.120(e)(3). The best solution is for employees and subcontractors to have certification in the 40-hour HAZWOPER course and, if staff will be performing supervisory duties, the 8-hour HAZWOPER supervisor's course.

1.6 PHYSICAL QUALIFICATIONS

1.6.1 PERSONAL QUALIFICATIONS

Trihydro employees will be physically, medically, and emotionally qualified to perform the duties to which they are assigned. Some factors to be considered in making work assignments are activity knowledge, strength, endurance, agility, coordination, and visual and hearing acuity. Trihydro employees will be able to read and understand English.

At no time while on duty may employees use or be under the influence of alcohol, narcotics, intoxicants, or similar mind-altering substances. Employees found under the influence or consumption of substances will be immediately removed from the jobsite. Trihydro reserves the right to test for substance abuse. As part of implementing the Company's program to deter alcohol, drug, and substance abuse, each employee may be requested to submit to a urine, blood, or other medical test at any time, with or without notice. All employees are further subject to "for cause" drug, alcohol, or substances testing. "Cause" is determined if the Company has reason to believe that a covered worker has used illegal drugs or has misused alcohol, prescription medication, or over-the-counter drugs. Such reason may be, but is not limited to, the following: accidents, injuries, near misses, excessive absences, tardiness, altercations, lengthy absences, possession of drugs, or thefts. This policy applies to, but is not limited to, Trihydro employees and subcontractors.

Operators of equipment or vehicles will be able to read and understand the signs, signals, and operating instructions in use. Where permits are required to operate specified equipment, the employee will have the permit on hand.

1.6.2 MEDICAL SURVEILLANCE REQUIREMENTS

In accordance with 29 CFR 1910.120(f), Trihydro employees and subcontractors that are covered by contractual agreements with Trihydro performing tasks outlined in this HASP will meet the following medical surveillance requirements with medical examinations and consultations:

- Before assignment.
- Project field-team members at least once every 12 months.

- At termination of employment or reassignment.
- As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation.

1.6.3 EXPOSURE-ASSESSMENT PLAN

As a component of Trihydro's H&S Management System, the H&S Team coordinates annual exposure sampling events for hazardous environments per the corporate Exposure Assessment Plan. The results are compiled, analyzed, recorded, and reported to management and employees per the plan.

1.7 PRE-ENTRY BRIEFING

In accordance with 29 CFR 1910.120(b)(4)(iii), Trihydro employees and subcontractors that are covered by contractual agreements with Trihydro performing tasks outlined in this Master HASP will receive a pre-entry briefing:

- Before initiating site activities
- Before work activities if there are changes to this Master HASP or site EAP
- Before work activities if there are changes to the recognized hazards (i.e., seasonal changes, new hazardous substance exposure, etc.)

Trihydro employees and subcontractors will complete the ***Pre-Entry Briefing Acknowledgement Form*** portion of this HASP after each pre-entry briefing.

1.8 DAILY SAFETY BRIEFINGS

The site PM, or assigned project supervisor, will conduct a daily site safety briefing covering the scope of work (general type of work), tasks for the shift, PPE, associated chemicals and their hazard controls, site and task associated hazards, permits needed, special equipment/techniques, communications, hospital information, and any special topics. The "Daily Tailgate Safety Meeting" form will be used to document the meeting; see **Appendix E**.

Subcontractors will be included in the daily safety briefings to provide effective coordination between Trihydro and contracted employees.

1.9 EFFECTIVENESS OF THE SITE HEALTH AND SAFETY PLAN (HASP)

In accordance with 29 CFR 1910.120 (4)(iv), inspections should be conducted by the PSHSO as necessary to determine the effectiveness of the site EAPs and Master HASP. Deficiencies in the effectiveness of the site EAPs and Master HASP will be corrected by the employer.

The "Health and Safety Plan Effectiveness Audit Form," found on the H&S Forms Web page, will be used to annotate and report deficiencies to the Corporate H&S Team.

2.0 SITE TASKS AND OPERATIONS

The following activities are anticipated to be performed at this site:

- LDAR Monitoring
- Oversight of drilling activities and monitoring well installation
- Soil sampling
- Groundwater sampling and fluid level gauging
- Oversight of soil excavation
- Groundwater monitoring well development
- Implementation of remedial alternatives
- Monitoring Well Abandonment
- Vehicle Operations

2.1 SITE MAP

Site maps can be found in the site-specific EAPs, if provided. Project team members and subcontractors need to be familiar with the site maps, if available.

2.2 SITE ACCESS

Site access will be discussed before project kick-off. See site-specific EAP for detailed access procedures for each site.

2.3 SITE SECURITY

For client-controlled sites, Trihydro employees and subcontractors will follow the client's security policies and procedures. At any time, a Trihydro employee or subcontractor observes a breach in site security measures or suspicious activities that contradict security protocol, the client specified notification process will be initiated followed by reporting the situation to the Trihydro site PM.

Where Trihydro has responsibilities for security, a daily inspection of security measures will be conducted. Breaches in site security measures or suspicious activities that contradict security protocol, the situation will be reported to the Trihydro site PM.

3.0 PERSONNEL RESPONSIBILITIES

3.1 PROJECT TEAM RESPONSIBILITIES

Project personnel who have responsibility for the oversight of this project are:

Position	***Name***
Project Director:	Gary Risse
Project Manager (PM):	Kathy Brown
Project Site Health and Safety Officer* (PSHSO):	Various
Trihydro Team Members:	Trent Foky
	DJ Creek
	Kyle McDonald
	Allie Wolverton
	Nate Dodge

*The PSHSO(s) will be a member who is present at the project site.

The project team responsibilities are listed below. It is the responsibility of the PM to verify that the field team has access to this HASP and supportive documentation and reads the safety procedures. It is the individual's responsibility to bring to the attention of the PM, or Corporate H&S Manager, portions of this HASP and related training that he/she does not fully understand.

Site employees and subcontractors will conduct safety meetings at appropriate intervals to verify that personnel are fully informed of potential hazards. Attendance at safety meetings is to be documented, and attendance sheets signed by personnel in attendance. The attendance sheets will be retained by Trihydro and made available to the appropriate client representative on request. Trihydro's "Daily Tailgate Safety Meeting" form can be found as **Appendix E**.

3.1.1 PROJECT MEMBERS

Trihydro is a strong advocate for Behavior-Based Safety (BBS) where the "one team" approach to safety is highly supported. Project members, to include subcontractors, are expected to perform Work-Site Self-Assessments (WSSA), conduct task observations, exercise the right of Stop Work Authority and to refuse unsafe work, review JSA forms, and report any unsafe conditions; all to promote the highest level of safety.

3.1.2 TRIHYDRO PROJECT DIRECTOR

The responsibilities of the project director with respect to safety are as follows:

- Verify that Trihydro field team personnel have read and understand this HASP
- Make available to the field team personnel the data known to him/her on this project site

3.1.3 TRIHYDRO PROJECT MANAGER (PM)

The responsibilities of the PM with respect to safety are as follows:

- ***Verify acceptable cellular reception at site before work commencement.***
- ***Verify route from site to hospital by driving the published route.***
- Coordinate initial site safety training for project team personnel as described in this document.
- Verify that field team personnel have read and understand this HASP.
- Verify that Trihydro field team personnel have the required materials needed before the start date to meet the requirements of this specific site HASP.
- Make available to the field team personnel and the appropriate client representative H&S information relevant to this project.

3.1.4 TRIHYDRO SITE PROJECT MANAGER

The responsibilities of the site PM with respect to safety are as follows:

- ***Verify acceptable cellular reception at site before work commencement***
- ***Verify there are no route obstructions (i.e., construction) from the site to the hospital***
- Conduct the daily safety briefing

- Coordinate efforts and communicate site tasks with other site contractors
- Establish communications between other site contractors via phone or radio to enhance coordination in the event of an emergency

3.1.5 TRIHYDRO PROJECT SITE HEALTH AND SAFETY OFFICER (PSHSO)

The responsibilities of the Trihydro PSHSO with respect to safety are as follows:

- Verify that work performed by Trihydro is conducted in accordance with safe practices outlined in this HASP
- Communicate to workers what is expected of them
- Note weather conditions
- Identify and schedule training
- Calibrate air and personal monitoring equipment
- Identify and remove hazards where possible
- Monitor activities for the proper use of PPE specified in this HASP, such as respirators with appropriate filters and/or canisters, protective coveralls, gloves, safety boots, protective eyewear, ear plugs, and hard hats
- Make PPE equipment available
- Monitor PPE usage, storage, maintenance, and replace when necessary
- Verify that safety equipment to be used by field team personnel is maintained in usable condition
- Use only safe work practices
- Initiate emergency phone calls when an emergency or accident requires medical attention
- Correct unsafe conditions and behaviors immediately
- Conduct additional health and safety meetings deemed necessary
- Report problems to the PM

3.1.6 TRIHYDRO FIELD TEAM MEMBERS

The responsibilities of the Trihydro field-team members with respect to safety are as follows:

- Become thoroughly familiar with this HASP and its supportive documentation
- Actively participate in this project HASP

- Follow safety standards and safe work practices set by Trihydro, the client, and regulatory agencies
- Refuse to perform work when unsafe conditions exist
- Report potential hazards to the PSHSO
- Immediately report potential hazards, accidents, incidents, injuries, and illnesses to the PSHSO
- Inform PM of contact lens use
- Inform the PM if allergic to insect stings/bites or other biological hazards
- Inform the Trihydro Health Insurance Portability and Accountability Act (HIPAA) Officer of the Risk Management Office if on medication that can impair their physical and/or cognitive abilities to perform their duties
- Use PPE when needed
- Inspect PPE and safety equipment before use
- Have required equipment operating permits on person
- Be familiar with the location, type, and operation of site and facility emergency equipment and procedures

3.1.7 SUBCONTRACTOR TEAM MEMBERS

The responsibilities of the subcontractor-team members with respect to safety are as follows:

- Perform work safely
- Read and understand subcontractor HASPs
- Adhere to applicable HASP protocol
- Provide applicable health and safety monitoring
- Report unsafe acts to Trihydro's PSHSO
- Properly inspect and maintain heavy equipment and other machines in compliance with applicable sections of the federal and State Occupational H&S Codes
- Supply and maintain PPE specified in this HASP, such as respirators with appropriate filters and/or canisters, protective coveralls, gloves, safety boots, protective eyewear, ear plugs, and hard hats
- Enforce corrective action in cooperation with the client and Trihydro's PSHSO
- Inform Trihydro's PSHSO of the presence of potential health or safety hazards

- Be aware and alert for signs and symptoms of potential exposure to site contaminants and climatic or acoustic stress
- Inspect PPE and safety equipment before use
- Inform PM of contact lens use
- Inform the PM if allergic to insect stings/bites or other biological hazards
- Inform their company HIPAA Officer if on medication that can impair their physical and/or cognitive abilities to perform their duties
- Have required equipment operating permits on person
- Be familiar with the location, type, and operation of site and facility emergency equipment and procedures

4.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personnel will understand and follow the Trihydro PPE Program. **Tables 4-1 and 4-2** provide more guidelines on PPE selection.

The following is a list of PPE anticipated to be used on this site based on the listed tasks, operations, and provided JSA forms:

Eye and Face Protection

- ☒ Safety Glasses
- ☐ Face Shield
- ☐ Chemical Goggles

Body Protection

- ☒ Fire-Retardant Clothing
- ☐ Tyvek Coveralls
- ☐ Chemical-Resistant Coveralls
- ☐ Chemical-Resistant Apron
- ☒ High-Visibility Safety Vest
- ☐ Cooling Vest
- ☐ Lightning-Strike Indicator

Water Safety

- ☐ Personal Flotation Device
- ☐ Waders
- ☒ ***Other:*** H_2S Monitor
- ☒ ***Other:*** 4-gas Meter

Hand Protection

- ☒ Industrial Work Gloves
- ☒ Chemical-Resistant Gloves
- ☒ Laceration-Resistant Gloves

Fall Protection

- ☐ Barriers/Guard Rails
- ☒ Body Harness w/Lanyards
- ☐ Anchorage Devices

Foot Protection

- ☐ Leather Boots
- ☒ Safety-Toed Boots
- ☐ Chemical-Resistant Boots

Head Protection

- ☒ Hard Hat
- ☐ Hard-Hat Liner

Respiratory Protection*

- ☒ Half-Face Respirator
- ☐ Full-Face Respirator
- ☐ Chemical Cartridge
- ☐ Particulate Filter
- ☒ Cartridge/Filter Combo
- ☐ Ammonia Cartridge
- ☐ H_2S Escape Cartridge
- ☐ Asbestos Filter

Hearing Protection

- ☒ Ear Plugs
- ☒ Earmuffs

Biological Protection

- ☒ First-Aid Kit
- ☒ Blood-borne Pathogen Spill Kit
- ☒ Insect Repellent
- ☐ Snake Gaiters

*Assigned Protection Factors (APF) for determining Maximum Use Concentrations (MUC) and for appropriate respirator selection can be found in the **Table 4-3** titled "Respirator Assigned Protection Factor (APF)."

5.0 AIR (AREA) AND PERSONAL MONITORING, AND ENVIRONMENTAL SAMPLING

The following is a list of monitoring/sampling devices expected to be used on this site for the listed tasks and operations:

Air (Area) Monitoring ☒ N/A	***Personal Monitoring***	***Environmental Sampling***
☐ Photo-Ionization Detector	☒ H_2S Monitor	☒ DO/ORP Meter
☐ Combustible Gas Indicator	☐ Ammonia Monitor	☒ pH Meter
☐ Multi-Gas Detector	☒ Multi-Gas Detector	☒ Turbidity Meter
☐ Flame Ionization Detector	☒ Colorimetric Tube	☒ Conductivity Meter
☐ Colorimetric Tube	Benzene Detection Tubes	☒ Temperature Gauge
_____	*(Specify)*	☒ Photo-Ionization Detector (PID)
(Specify)	☐ Other:	☐ Flame-Ionization Detector (FID)
☐ Other:	_____	☐ Other:
_____	*(Specify)*	_____
(Specify)		*(Specify)*

5.1 PERSONAL MONITORING

The methods for monitoring the atmospheric conditions in a worker's breathing zone are very similar to area sampling and monitoring. Again, the operator will be trained in their use and the appropriate equipment will be utilized so that the device is capable of detecting the specific site hazard. Personal monitoring devices will be worn in the breathing zone of the employee.

The manufacturer's manual for the specific device will be kept on site for reference.

5.1.1 FREQUENCY

Personal exposure monitoring will be conducted on a continuous basis (minimum every 15 minutes) if there is a potential exposure risk.

5.1.2 CALIBRATION, BUMP TESTING, AND MAINTENANCE

Non-disposable instruments will be bump tested at the beginning of each day with the manufacturer's recommended calibration gas. Calibration will be performed at a minimum quarterly or sooner if exposed to large doses of contaminants. Trihydro equipment will be calibrated and maintained by the Corporate H&S Team unless otherwise dictated by the team. Rental equipment will be calibrated and maintained by the rental company, or by Trihydro employees if calibration equipment is available.

Employees are to perform a daily function test on disposable personal monitors before commencing work on site.

Calibration results are to be recorded on an "Air Monitoring Equipment Calibration Tracking Form."

Bump testing and function test results are to be recorded on a "Personal Detector Bump Check Record."

5.1.3 DEVICE TYPES

The same devices used for air monitoring can be used for personal monitoring. However, typically, personal monitors are smaller in size and are usually passive devices (not pump driven). The devices can be single gas detectors or multiple.

5.1.3.1 HYDROGEN SULFIDE (H_2S) DETECTOR

Project members are to wear a hydrogen sulfide (H_2S) detector when on site. The low-level alarm is to be set at 10 ppm and the high-level at 15 ppm. The action levels are listed in **Table 5-2.**

The manufacturer's manual for the specific device will be kept on site for reference.

5.1.3.2 MULTI-GAS DETECTOR

A multiple gas detector can be taken into the field to provide personal monitoring (one instrument per person or group) to sample and monitor the work atmosphere. The multi-gas detector will be set up to monitor, at a minimum, oxygen (O_2) levels, LEL, and chemical PELs. The multi-gas detector will monitor for potential hazardous atmospheres of:

- <19.5% O_2
- >20% LEL (>10% for permit-confined space operations)

- >PEL
  - H_2S (low alarm set at 10 ppm, high alarm 15 ppm)
  - CO (alarm set at 35 ppm)

The manufacturer's manual for the specific device will be kept on site for reference.

5.2 ENVIRONMENTAL SAMPLING

Multiple hazards should be considered when preparing for environmental sampling activities. Hazards may include but are not limited to calibration solutions, calibration gases, sample locations, sampling environment, sample media, and sampling activities. Before completing environmental sampling, the appropriate JSA form should be completed by the sampling team and reviewed by the PM. JSA forms would cover, but not be limited to, sampling activities, equipment calibration, and sampling equipment maintenance. Environmental sampling and the development of JSA forms may be completed for a variety of media and should be completed in general accordance with site specific Sampling and Analysis Plans (SAP), Quality Assurance Project Plan (QAPP), and or the USEPA Groundwater RCRA groundwater monitoring guidelines.

5.2.1 TECHNIQUES

Environmental sampling techniques should be completed in general accordance with site specific SAPs, QAPPs, and or the USEPA Groundwater Sampling Technical Guidance Document (TGD).

5.2.2 INSTRUMENTATION

The manufacturer's manual for the specific devices used will be kept on site for reference. Caution will be used whenever using chemicals or compressed gases for calibration of monitoring equipment. Use recommended PPE based upon potential hazards as defined in the job specific JSA.

5.2.2.1 DO/ORP METER

A combination Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP) meter will be used at the site during groundwater sampling. The DO meter is an electronic device in which oxygen diffuses across a membrane in a submerged probe, to complete an electrical circuit. It records the dissolved oxygen concentration in milligrams per liter or percentage saturation. ORP meters measure the very small voltages generated when the measuring probe is placed in water in the presence of an oxidizing agent. The electrode is made of platinum or gold, which reversibly loses its electrons to the oxidizer. A voltage is generated which is compared to a silver electrode in a silver salt solution, similar to a pH probe. The more oxidizer available, the greater the comparative voltage generated between the two probes.

5.2.2.2 PH METER

A pH meter is a high impedance voltmeter for the measurement of electrode potential.

5.2.2.3 TURBIDITY METER

A turbidity meter will be used at the site during groundwater sampling. Turbidity refers to the concentration of un-dissolved, suspended particles present in a liquid and is a measure of the clarity of a sample. Turbidity measurement is achieved by analyzing the amount of light refracted from suspended particles such as clay, silt, and organic material.

5.2.2.4 CONDUCTIVITY METER

A conductivity meter will be used at the site during groundwater sampling. Conductivity is the ability of a material to conduct electric current and is measured by placing two plates (enclosed in the meter end) in the sample, a potential is applied across the plates, and the current that passes through the solution is measured.

5.2.2.5 TEMPERATURE METER

A temperature meter will be used at the site during groundwater sampling. Temperature refers to the kinetic energy of molecules making up substance, vibrating and bouncing against each other. Temperature meters measure temperature by reading the current across the sensor after a potential is applied across the sensor. The meter then converts the current reading into temperature.

5.2.2.6 PHOTO-IONIZATION DETECTOR (PID)

A type of OVM known as a PID will be used during this project if hydrocarbon-impacted materials are encountered. The PID used for this project will be equipped with a 10.6 eV lamp or greater. Monitoring will be conducted using one PID per work zone. Areas downwind of the work zone will also be monitored, if necessary, to verify organic vapor emissions do not impact off-site areas.

5.2.3 CALIBRATION AND MAINTENANCE

Each instrument will be tested at the beginning of each day in accordance with the manufacturer's recommendations. Calibration will be documented and performed in accordance with the manufacturer's recommendations or sooner if warranted. Trihydro equipment will be calibrated and maintained by field personnel on a daily basis. Rental equipment will be calibrated and maintained at a minimum according to manufacturer's recommendations. Field equipment will be calibrated to the extent practicable before use each sampling day.

6.0 SITE CONTROL PLAN

Project-team members and subcontractor employees need to review the site maps in the EAPs, if available, to become familiar with the site layouts, work zones, and emergency plan components such as evacuation routes and assembly points.

Entry into a hazardous environment requires the "buddy system" of two personnel where each employee is observed by the other to provide rapid assistance in the event of an emergency. ***If there are no actual or potential exposures to hazards that would incapacitate the individual, then refer to the Lone Worker Safety Procedures.***

The following are recognized hazards at the site throughout the project period; personnel will be familiar with the associated health and safety policy, procedure, or plan corresponding to each hazard.

Physical Hazards

- ☒ Machine Guarding
- ☒ High Pressurized/Temperature Process
- ☒ Lockout/tagout
- ☒ Housekeeping
- ☒ Ground Level Slips, Trips, and Falls
- ☒ Ladder Use
- ☒ Falls from Heights
- ☒ Knife Safety

Electrical Hazards

- ☐ Electrical-qualified Persons
- ☐ Extension Cords
- ☐ Ground Fault Circuit Interrupters (GFCI)
- ☒ Overhead Power Lines
- ☒ Inclement Weather/Lightning
- ☒ Utilities Clearance
- ☐ Water Hazards
- ☒ Fire/Explosion Hazards
- ☐ Hot Works
- ☒ Chemical Hazards
- ☒ Asbestos Hazards

Natural Disaster

- ☐ Earthquake
- ☒ Tornado
- ☐ Wildfire Smoke Hazards

Climatic Hazards

- ☒ Heat Stress
- ☒ Cold Stress
- ☒ Ergonomic Hazards
- ☒ Acoustical Hazards
- ☒ Dust Hazards
- ☒ Silica Hazards
- ☒ Excavation Hazards
- ☒ Drilling Activities

Traffic Hazards

- ☒ Driving Safety
- ☒ Vehicular Safety
- ☒ Powered Industrial Trucks
- ☒ Removal/Hauling Operations
- ☐ Contaminated Soil Truck
- ☒ Confined Space Entry

Biological Hazards

- ☒ Bloodborne Pathogens
- ☒ Hantavirus
- ☒ Histoplasmosis
- ☒ Psittacosis
- ☒ Chiggers
- ☒ Stinging Insects
- ☐ Fire Ants
- ☒ Lyme Disease (Ticks)
- ☒ West Nile Virus
- ☒ Valley Fever (AZ, CA, NV, NM, TX, and UT)
- ☒ Snakes
- ☒ Spiders
- ☐ Scorpions
- ☒ Poison Oak/Ivy/Sumac
- ☐ Rabies
- ☐ Alligators
- ☐ Africanized Honey Bees

6.1 HAZARD CONTROL HIERARCHY – ORDER OF PRECEDENCE

Site hazards and hazards resulting from investigation and remediation activities may be controlled using one or more of the control measures listed below. The order of precedence is as follows:

- ***Engineering Controls:*** A major component of the design phase is to select safety features to eliminate a hazard and render it fail-safe or provide redundancy using backup components. Examples of engineering controls include, but are not limited to: mechanical ventilation; sound-proofing; machine guarding; etc.
- ***Administrative Controls:*** Hazards that cannot be totally eliminated by engineering controls can be controlled through administrative controls. Examples of administrative controls include, but not limited to: warning signs; personnel change out; specialized training; established procedures; etc.
- ***Personal Protective Equipment (PPE):*** To protect workers from injury, the last method in the order of precedence is the use of PPE. Employees need to understand that the use of PPE does not remove the risk. PPE such as hard hats, gloves, eye protection, life jackets, and other protective equipment can be bulky, cumbersome, and heavy where often it is discarded or not used, rendering this method ineffective without proper controls.

6.2 SAFE WORK PRACTICES

The following section presents procedures on how to address the hazards expected to be encountered during site activities for this project. During times when site operations are under the observation of a Trihydro representative, Trihydro will notify contractor personnel on site and a client representative if an unsafe condition is observed.

6.2.1 STOP WORK AUTHORITY/RIGHT-TO-REFUSE UNSAFE WORK PROGRAM

Employees not only have the right to refuse unsafe work, they also have the right to stop unsafe practices of others. The stop work authority program gives any employee working onsite the ability to stop all work related to a specific activity being performed in a manner in which there is an imminent danger to personnel, property, or the environment. All employees and contractors are responsible for participating in the stop work authority program.

The stop work order is binding until either the employee who stopped the work or the site PM rescinds the order. The site PM is the only individual who can overrule the employee who initially stopped the work.

NOTE: The requirements and responsibilities identified in the stop work authority program may cross company boundaries. For example, a Trihydro employee may identify a subcontractor performing an unsafe act or creating an unsafe condition and stop the work, or vice versa. Any unsafe act or condition identified must be investigated and corrected by either the employee who stopped the work or the site PM.

Any employee who identifies an unsafe act or condition that warrants a stop work order shall immediately conduct the following:

- Notify affected employees (includes workers in the general area)
- Take the appropriate actions necessary to protect workers, the public, the environment, and the property
- Notify immediate supervisor
- Notify site PM if different from immediate supervisor

Affected employees will immediately comply with the stop work order until either the employee who stopped the work or the site PM rescinds the order.

Every stop work order will be investigated and corrected as soon as possible. Individuals involved in the investigation will be determined by the site PM. The results of the investigation shall be communicated to all affected employees including the employee who initially stopped the work and the site PM.

No employee will receive any kind of reprisal, retribution, or discipline for exercising a stop work authority.

6.2.2 WORK AREA EVALUATION FOR CONFINED SPACES

The project team will evaluate their work areas for confined spaces using the "Work Area Evaluation for Confined Spaces," **Appendix F.** The form is used to determine if there are non-regulated spaces, confined spaces, or permit-required confined spaces in the work area. The project team will use completed forms to communicate the type and location of the spaces to team members. Completed forms will be kept in the project folder.

The project team will re-evaluate their work areas if the space configuration or hazards change.

6.2.3 HAND-INJURY PREVENTION

Employees are expected to assess their tasks for physical, chemical, and thermal hand hazards and implement engineering and administrative controls, and PPE, or a combination of the three.

6.2.3.1 ENGINEERING CONTROLS

Engineering controls prevent the physical placement of the employee's hand in harm's way. An example is machine guarding to protect from hazards such as those created by point of operation (area on a machine where work is actually performed), ingoing nip points, rotating parts, flying chips, and sparks.

6.2.3.2 ADMINISTRATIVE CONTROLS

Administrative controls are designed to make an individual aware of the hazard and, therefore, limit their exposure. Administrative controls may include training, labeling, signs, and safe work practices and procedures.

6.2.3.3 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Gloves can protect against chemical exposure, lacerations, and thermal hazards. However, employees need to understand that one type of glove does not protect against all hazards. Employees need to match the right glove material with each application or task. This includes assessing the job for chemical exposures, pinch points, laceration hazards, thermal risks, abrasion exposure, puncture risks, and then selecting the appropriate glove based on material, thickness, length, and other traits. Clients may have strict guidelines for proper glove selection, so get with your PM for more details.

Table 6-1 provides employees with more glove selection guidance.

Warning: Loose fitting clothing, including loose fitting gloves and unbuttoned sleeve cuffs, must not be worn around rotating or moving equipment such as, but not limited to, power transmission shafts, pulleys, feed rolls, drill presses, power augers, and rotating stock!

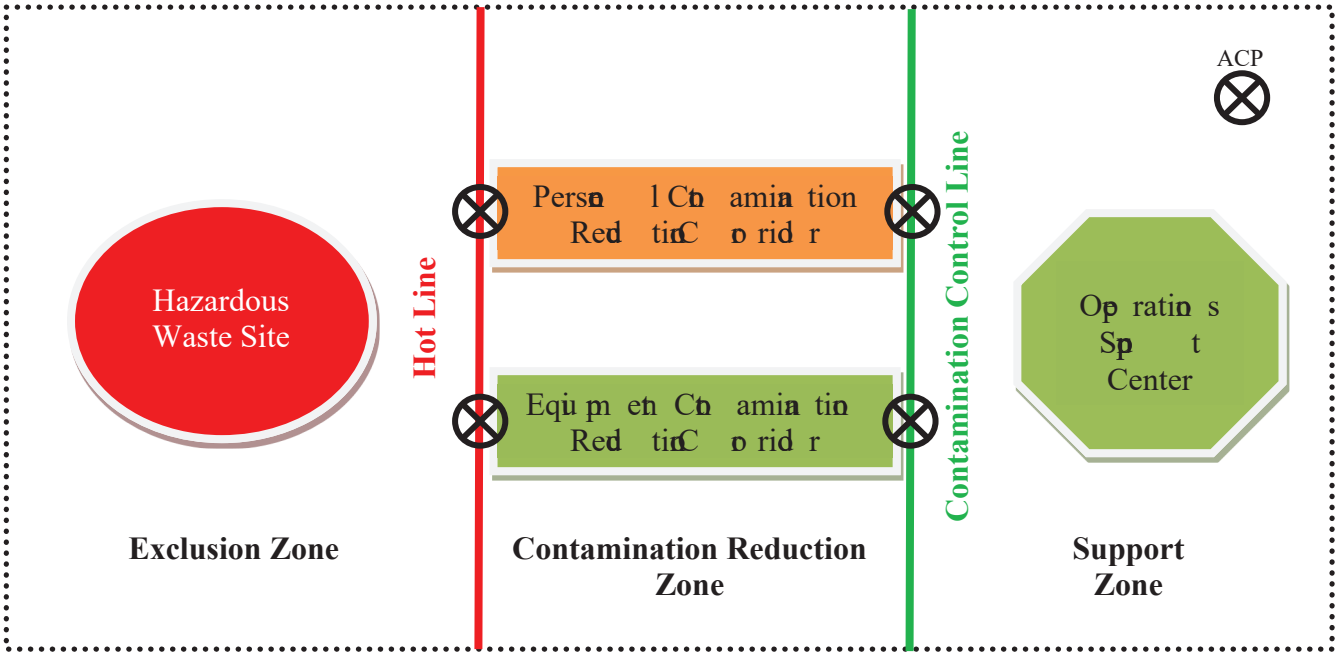
6.3 WORK ZONE ACCESS

The work zone is defined as the area within a 30-foot radius of persons working in the area. Barricades and other entry restricting equipment will be used at the discretion of the PM or PSHSO to prevent the work zone entry of unauthorized personnel. Only authorized personnel will be permitted to enter the work zone. Authorized personnel will include those who have duties requiring their presence in the work zone. The Trihydro PM has the right to require unauthorized personnel to exit the work zone.

Pedestrian and vehicle traffic control plans will be developed and documented as an addendum to the HASP when the potential exists for pedestrian and/or vehicular traffic to pass through or nearby the work zones. The control plans will provide: pedestrian/vehicle diversions around or away from the work zones; clear guidance through the diversion; and

prevent pedestrian/vehicle/work zone interaction that would result in incidents. Requirements for submitting traffic control plans with controlling authorities need to be completed in accordance with their guidelines.

6.3.1 HAZWOPER EXCLUSION ZONE ACCESS



During HAZWOPER operations, it may be necessary to set up work zones to control chemical exposures. The Exclusion Zone (or hot zone) is the area with actual or potential contamination and the highest potential for exposure to hazardous substances. Therefore, the Exclusion Zone requires the highest level of PPE determined for the area. If workers are entering the Exclusion Zone under suspected or actual immediately dangerous to life and health conditions, there must be one standby rescuer in the same level of protection for each entrant. Standby rescuers are staged in the Support Zone (or are cold zone ready) to enter the Exclusion Zone at a moment's notice.

Exclusions zones will vary based on the tasks performed on a daily basis. If multiple exclusions zones are established, wind direction and topographical layout need to be considered to prevent exposing workers in other work zones.

Work zones must be well-marked and the boundaries visible. Work zone boundaries are established after evaluating the potential for hazardous substances to migrate through air, soil, or water.

Smoking, eating, drinking, and applying makeup or lotions within the Exclusion or Contamination Reduction Zones is prohibited.

Workers are to enter the Exclusion Zone through the CRZ (or warm zone) via the Access Control Points (ACP). Workers are to exit the Exclusion Zone through the CRZ personnel decontamination stations while equipment is decontaminated at the equipment decontamination stations.

6.3.1.1 BUDDY SYSTEM AND COMMUNICATIONS

Workers in the Exclusion Zone are to use the "buddy system" to facilitate a quicker response in the event of an emergency. Exclusion Zone entrants need to work in groups so as to have effective communication with one another and have visual contact to monitor others for signs and symptoms of exposure and other emergencies. Key responsibilities of buddies are to:

- Provide partners with assistance
- Observe partners for signs of chemical or heat exposure
- Periodically checking partners' PPE
- Notify the PM or other site employees if emergency assistance is needed

The PM needs to establish effective communication with the Exclusion Zone entrants before entry. Various systems can be used to include:

- Radio: including FM and CB (intrinsically safe for explosive atmospheres)
- Noisemakers: such as bells, air horns, megaphones, sirens, whistles
- Visual signals: such as flags, hand signals, lights, signal boards, body movements

6.3.2 WORK PERMITS

Work permits may or may not be required on project sites; however, the client reserves the right to regulate specific areas by the use of work permits such as general work permits, hot work permits, high hazard permits, and permit-required confined space permits. If the client has specific permit requirements, or if hot works or permit-required confined space operations are anticipated, review the Trihydro and client specific procedures before initiating the tasks.

6.3.3 LONE WORKER SAFETY PROCEDURES

To provide an effective means of communication between a single field team member and the project management group, site Lone Worker Safety Procedures will be established by the PM. The primary consideration is the type of activities that will be performed that could result in exposure to an incapacitating situation. ***If there are no expected or***

potential exposure to hazards that would incapacitate the individual, then Lone Worker Safety Procedures are acceptable.

The following criteria need to be met before performing tasks at the project site under the Lone Worker Safety Procedures:

- Perform a Work Site Self-Assessment to determine if the task has high risk that would require the buddy system.
- Verify that cellular phone use in the work area does not pose an additional hazard or is not against the client's policy.
- The lone worker needs to possess a cellular phone that is turned on, kept on person, and charged. If working in a noisy environment, set the phone to vibrate.
- Cellular phone reception needs to be verified to be at a sufficient level. If cellular coverage is not sufficient, a booster needs to be issued to the individual.
- Supervisors away from the office will carry a cellular phone, turned on, kept on person, and charged.
- The lone worker needs to carry identification (ID) on their person and in vehicles (company ID badge, driver's license, etc.).
- If the client policies require, company vehicles need to have the company name and office phone number displayed.

The following communication protocol needs to be implemented:

- Field personnel would advise their supervisors of their work schedule.
- The lone worker needs to contact supervision at the start of the day, mid-day, and a final status report call at the end of the day. The client will be notified in accordance with their policies.
- Communication with additional contacts, such as family and friends, is encouraged.
- If a lone worker misses a scheduled communication, they need to be contacted to verify their status within 15 minutes of the scheduled check in time. If the lone worker does not answer after three call attempts, a person will be sent to the work site to check on their status.

6.4 PHYSICAL HAZARDS

PPE is designed to protect field team personnel from some physical hazards expected at the work site. However, the field team personnel will be aware of potential physical hazards and remain alert during field work. The following procedures will be implemented to minimize the potential for injury from physical hazards.

6.4.1 MACHINE GUARDING

Machine guarding will be designed to prevent hands, arms, or any other part of an employee's body from making contact with dangerous moving parts or from entering the point of operation. A guard will not only prevent accidental contact but will prevent employees from intentionally going around or bypassing the guard.

6.4.2 HIGH PRESSURIZED/TEMPERATURE PROCESSES

Potential energy can be released from various pressurized or high temperature process equipment or components that could result in injury or death. When conducting environmental activities, no team member, unless trained and authorized by the client, is to conduct lockout / tag out (LOTO) activities on equipment located on site.
Below is list of procedures to follow when working around pressurized/high temperature processes. Notify the applicable client representative or your PM if you identify items listed below.

- Look for evidence of oil or air leaks on the surfaces of flexible hoses or at the point at which the hose in question joins the metal end couplings.
- Look for abnormal deformation of the outer covering of hydraulic hoses.
- Look for leakage at connections.
- Look for evidence of abrasive wear that could have reduced the pressure retaining capabilities of the hose or tube affected.

Allow equipment to cool before conducting environmental activities.

LOTO may be required depending on the type of work being conducted on or around the equipment. Contact the applicable True Companies representative before conducting work on equipment to verify proper training under OSHA CFR 1910.147 regulations and client expectations.

6.4.3 LOCKOUT / TAG OUT (LOTO)

Maintenance activities requiring lock out of hazardous energies (LOTO) is expected to be conducted by Trihydro subcontractors. Applicable team members will follow the site/equipment procedure and additional requirements in the client LOTO Program. Lock out is preferred over tag out. Trihydro team members and subcontractors will follow LOTO procedures for each piece of equipment serviced during site activities. If a LOTO procedure is not posted or you have questions on the written procedure contact Trihydro's PSHSO before servicing the equipment. ***Employees will not conduct maintenance, repair, or inspection on equipment without first being trained on the LOTO procedures and, second, verifying energy sources have been de-energized.*** Each trained "authorized" employee shall have their own lock and tag. (Trihydro's PSHSO is responsible for administering the proper LOTO equipment, training the field team members on the procedure, and checking procedures are followed).

If a piece of equipment has a single energy source, the basic steps for LOTO can be followed without the need for written procedures. If the equipment is complex or has multiple energy sources, then there must be equipment-specific written procedures kept at the place where maintenance is performed. If there are multiple pieces of equipment that are very similar, such as well pumps, then a single written procedure can cover that "family" of equipment.

Equipment powered by a single electrical cord does not fall under LOTO procedures as long as all the following is followed:

- The cord is within reach
- The cord is in view
- If neither can be maintained, then a lockout device will be applied

The basic steps for lock out are as follows:

1. Review applicable True Companies LOTO policies
2. Develop JSA forms for work to be conducted
3. Notify affected individuals that equipment will be shut down
4. Turn off equipment requiring service
5. Locate the equipment-specific energy source

6. Lock out the energy source to the equipment using energy isolation devices and dissipate stored energy
    - Each Trihydro employee performing the work will place their lock on the energy isolation device. If multiple employees will be working on the equipment, a gang hasp will be used to allow the employees to place their lock on it to control the energy source.
    - Lock-out locks and keys are provided by Trihydro. Each employee working on the equipment will have a lock with a single key controlled by that employee.
7. Place a tag-out tag on the lock, initial, provide a contact number, and date it
8. Dissipate residual energy
9. Verify that the area is clear and try starting the equipment to confirm that the equipment is dead
    - If proper lock out is verified, then servicing may be conducted.
    - If proper lock out is not verified, do not proceed and notify the Trihydro PM immediately.
10. After maintenance is complete, replace guards, shields, and other safety devices and remove tools and other equipment from the equipment area
11. Verify personnel are clear of the equipment area
12. Remove locks and tags
13. Re-start the system

6.4.4 HOUSEKEEPING

The first requirement for safe field operation is that the field team understands and fulfills the responsibility for maintenance and "housekeeping" during site environmental activities.

6.4.4.1 GENERAL HOUSEKEEPING

- Suitable storage locations will be provided for tools, materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the crew or a visitor.
- Work areas, platforms, walkways, scaffolding, and other access ways will be kept free of material, debris, obstructions, and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous.

- Gasoline will not be stored in portable containers other than a non-sparking, red container with flame arrester in the fill spout and having the word “gasoline” easily visible on the container.
- Store and secure necessary equipment outside the work zone until use is required.
- Mitigate icy conditions within the work zone and along pathways.

6.4.5 GROUND LEVEL SLIPS, TRIPS, AND FALLS

To prevent slips, trips, and falls, take extra precaution if you encounter the following situations:

- Loose, irregular surfaces, such as gravel, shifting floor tiles, and uneven sidewalks can make it difficult to maintain your footing.
- Oil, grease, and other liquids can make walking surfaces extremely slick.
- Obstructed aisles or walkways present tripping hazards or require frequent changes of direction, which can throw you off balance.
- Insufficient light can make it difficult to see obstacles and notice changes in the walking surface.
- Shoes with slick soles provide insufficient traction.
- Carrying items can both obstruct your vision and impair your balance.
- Inattention and distraction interfere with your awareness of these hazards and increase your risk of injury.
- For snow covered terrain, follow already established safe trails.

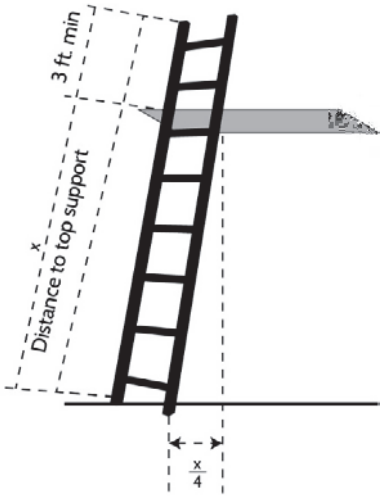
6.4.6 LADDER USE

Falls from portable ladders (step, straight, combination and extension) may be a hazard on this project.

Follow the tips below to protect yourself and other site workers:

- Always inspect the ladder prior to using it. If the ladder is damaged, it must be removed from service and tagged until repaired or discarded.
- Read and follow all labels/markings on the ladder.
- Avoid electrical hazards! Look for overhead power lines before handling a ladder. Avoid using a metal ladder near power lines or exposed energized electrical equipment.

- Always maintain a 3-point (two hands and a foot, or two feet and a hand) contact on the ladder when climbing. Keep your body near the middle of the step and always face the ladder while climbing (see diagram).
- Only use ladders and appropriate accessories (ladder levelers, jacks or hooks) for their designed purposes.
- Ladders must be free of any slippery material on the rungs, steps or feet.
- Do not use a self-supporting ladder (e.g., step ladder) as a single ladder or in a partially closed position.
- Do not use the top step/rung of a ladder as a step/rung unless it was designed for that purpose.
- Use a ladder only on a stable and level surface unless it has been secured (top or bottom) to prevent displacement.
- Do not place a ladder on boxes, barrels or other unstable bases to obtain additional height.
- Do not move or shift a ladder while a person or equipment is on the ladder.
- An extension or straight ladder used to access an elevated surface must extend at least 3 feet above the point of support (see diagram). Do not stand on the three top rungs of a straight, single or extension ladder.



- The proper angle for setting up a ladder is to place its base a quarter of the working length of the ladder from the wall or other vertical surface (see diagram).
- A ladder placed in any location where it can be displaced by other work activities must be secured to prevent displacement or a barricade must be erected to keep traffic away from the ladder.
- Be sure that all locks on an extension ladder are properly engaged.
- Do not exceed the maximum load rating of a ladder. Be aware of the ladder's load rating and of the weight it is supporting, including the weight of any tools or equipment

6.4.7 FALLS FROM HEIGHTS

Workers will be protected from falls when working at heights of 4 feet or more above the ground or next lower working elevation when covered by General Industry standards, 6 feet when covered by Construction standards, and 3 feet when covered by Mining Safety and Health Administration (MSHA) standards. The primary means of fall protection is through engineering controls such as guardrails and barricades. Other methods include lifelines and netting. In the event that fall hazards are encountered on the site, and if standard engineered fall protection is not feasible, Trihydro workers will use a Personal Fall Arrest System (PFAS).

- A PFAS consists of a full-body harness and shock-absorbing lanyard equipped with double-locking snaps. As of January 1, 1998, the 1994 OSHA rule prohibits the use of body belts as part of a personal fall arrest system.
- During the use of a PFAS, workers will utilize the buddy system where the second team member will remain on a nearby working platform as an observer to summon rescue services in the event of a fall.
- A relief step device that helps prevent suspension trauma will be incorporated into the PFAS.
- Only locking-type snap hooks will be permitted for use in personal fall arrest systems and positioning systems as of the same date.
- The lanyard will be attached to the D-ring in the center of the back or other manufacturer approved D-rings.
- Practicing "back biting" where the lanyard is wrapped around the anchorage point and snapped back on itself is unauthorized unless the lanyard is designed specifically for the practice.
- Tie-off will be to a structural member capable of supporting a 5,000-pound load in the event of a fall.
- The tie-off point will be as high as practical above the head.
- The lanyard can be no longer than 6 feet.
- Employees working near electrical equipment will use nylon or other non-conductive lanyards. Steel slings will not be used.
- PFAS equipment will be protected from damage and kept in good repair. Equipment involved in a fall will be immediately removed from service.
- Trihydro employees exposed to fall hazards will be trained in this procedure.

Fall protection equipment will be inspected before each use utilizing the Trihydro ***Fall Protection Equipment Inspection Form***, found on the H&S Forms Web page, which completed forms are filed in the project folder.

6.4.8 KNIFE SAFETY

Only self-retracting utility (safety) knives are to be used by Trihydro employees and subcontractors. Self-retracting (safety) knives add an important safety feature to the design. Like standard utility knives they can adjust quickly to different cutting depths and will let the blade retract completely into the handle when not in use. The difference is that the spring-loaded blades are pushed out of the knife body with finger pressure and then retract automatically when the pressure is released. This added safety feature will help keep our employees safer on the job site.

Here are some safety tips that apply when using utility knives:

- Once the blade is engaged into the material, release the finger pressure to allow blade retraction once material is cut.
- Use a sharp blade.
- Keep your free hand away from the line of cut.
- When making cuts on a surface below you, stand or kneel to one side of the line of the cut.
- Pull the knife toward you when making a cut on a flat surface. Because pulling motions are stronger and more positive than pushing motions, your knife is less likely to slip.
- When using a straight edge to guide a cut, either clamp it down or keep your free hand well away from the cutting path of the knife. Be sure the straight edge is thick enough to prevent the knife from "riding up" over the edge.
- With thicker materials, make several passes, cutting a little deeper into the material with each pass.
- Many tasks require a knife edge, but not a sharp point. For these tasks you can add protection against puncture wounds by using a rounded-tip blade.
- Use “imbedded” blades when possible such as for strapping, shrink wrap, and twine.
- Use scissor-type cutters (pipe cutter) when possible, such as with piping, hosing, and tubing.



Self-retracting Knife



Imbedded Blade



Pipe Cutter

6.5 ELECTRICAL HAZARDS

The potential exists for field team personnel to encounter electrical hazards, particularly during site activities. The following procedures will be implemented to minimize the potential for injury from electrical hazards.

6.5.1 OVERHEAD-POWER LINES

Overhead power lines pose a potential hazard when there is a possibility of contact. A 10-foot minimum clearance shall be maintained between equipment and energized lines with a power rating of 50 kV or less and then an additional 4 inches for every 10 kV over 50 kV. If the appropriate clearance cannot be maintained, the power lines shall be de-energized.

For drilling activities, the minimum clearance distance from the drill mast and overhead power lines is 20 feet.

Table 6-2 provides energized-line and equipment clearances.

6.5.2 INCLEMENT WEATHER/LIGHTNING

If thunder is heard within 30 seconds of sighting lighting, the lighting is close enough to be dangerous – seek shelter. Wait 30 minutes or more after the last lightning flash before leaving shelter.

6.6 UTILITIES CLEARANCE

Utilities, above and below ground, will be identified by type (electrical, natural gas, steam, telecommunications, etc.), rating, and location and annotated on the "Utilities Locate Acknowledgement Form," **Appendix G**, whenever they are deemed a hazard for tasks performed (e.g., excavations, drilling, equipment movement, etc.)

The project team will perform the following actions after calling One Call (811):

- Wait the required amount of time
- Confirm the utility response before digging to make sure the utilities companies have cleared the location
- If the marks are no longer reasonably visible, the excavator must contact USA to request new markings where utility company has 2 working days to respond

During soil disturbance, the project team is responsible for:

- Hand-expose utilities in conflict
- If damage is discovered or caused, call the facility owner or 911

6.7 FIRE/EXPLOSION HAZARDS

The potential exists for field team personnel to encounter fire/explosion hazards during site activities. The following additional precautions will be implemented to minimize the potential for fire or explosion:

- Use explosion-proof tools.
- After air vacuum and visual clearance procedures, (where applicable) drilling activities will proceed slowly for the first 5 feet to minimize damage to underground lines.

- If monitoring equipment detects organic vapors at or above 20% of the LEL of flammable gases, vapors, or mists, ignition sources will be eliminated.
- The possession of cameras, weapons, or explosives is prohibited without proper authorization from the appropriate True Companies representative.
- If abnormal fire, smoke, or heat emanates from areas on site, the field team personnel will immediately evacuate the area.

6.8 CHEMICAL HAZARDS

Governmental regulations require that Trihydro has one easy reference for important information regarding hazardous substances in the workplace. This information is contained on labels and in SDSs for each substance in the workplace. OSHA has updated the requirements for SDSs (formerly known as MSDSs) but will not fully regulate the new format until June 1, 2015. Also, OSHA has updated the requirements for labeling of hazardous chemicals under its Hazard Communication Standard (HSC). As of June 1, 2015, all labels will be required to have pictograms [consists of a symbol on a white background framed within a red boarder and represents a distinct hazard(s)], a signal word, hazard and precautionary statements, the product identifier, and supplier identification. Until that time, labels can be in the form of the National Fire Protection Agency (NFPA) diamond on buildings or the Hazardous Information System (HIMS) guidelines for containers with the hazards ranging from zero (no risk) to four (highest risk).

If a hazardous material is encountered that the employee is not familiar with, the employee will review the SDS for that material. Read labels and the SDS carefully, follow warnings and instructions, understand the signs of exposure and first aid response, use the correct protective clothing and equipment when directed, learn emergency procedures, and practice safe work habits. Employees will direct questions about a hazardous material to the PSHSO.

Site-chemical hazards and their associated exposure limits that employees may encounter are listed in **Table 6-3**.

- Hydrocarbon liquids and gases, which may adversely affect human health through injection, skin contact, and inhalation.
- Acidic and caustic solids or liquids, which may adversely affect human health through skin contact and inhalation.

If you have questions regarding chemicals located at the client's site, contact the PM.

The following procedures will be implemented to minimize potential harm from chemicals:

- The Trihydro PM will refer to the National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards for the proper response to hazardous organic chemicals if field team personnel complain of irritation, giddiness, headache, or nausea.
- Copies of SDSs can be found in **Appendix D**.
- If organic vapors are encountered, organic vapor measurement should be taken every 15 minutes in the breathing zone within the site. Employees need to refer to **Tables 5-1 and 5-2** "PID and FID Organic Vapor Action Levels and Responses."
- Trihydro's PSHSO will instruct field team members to stop work and leave the work zone if there are indications of exposure to acidic or alkaline substances (eye, nose, throat, or skin irritation; holes in clothes).
- Trihydro's PSHSO will instruct the field team members complaining of these symptoms to immediately flush the area of the body exhibiting the symptoms with cool or cold water.
- Trihydro's PSHSO will determine the pH of the apparent offending substance.
- If the pH is less than 1 or greater than 12 standard units, the field team personnel will be required to wear Tyvek coveralls, chemical resistant gloves, chemical resistant boots, splash goggles, and half-mask respirators with acid and particulate cartridges.
- Trihydro's PSHSO will instruct the field team personnel to minimize contact with the acidic or caustic substance.
- Chemicals will be stored with compatible chemicals in an area with secondary containment that will not allow a spill to enter into the environment.
- Chemicals not in their original container will be kept in a container compatible with the chemical and labeled with an HIMS label.

6.8.1 SITE CHEMICALS OF CONCERN



Based on historical environmental sampling data for the site, chemicals of concern at the site include the individual compounds present in petroleum hydrocarbons, including volatile and semi-volatile organic compounds and heavy metals in soil and groundwater. The primary chemicals that were detected at concentrations above cleanup standards include those listed in **Table 6-3**. This table is used as a reference; defer to the NIOSH Pocket Guide to Chemical Hazards and/or the SDS provided in **Appendix D**.

6.8.2 HAZARDOUS WASTE

Hazardous waste will be collected in containers compatible with the waste, stored in an area with secondary containment that will not allow a spill to enter into the environment, stored with compatible wastes, and labeled indicating the waste nomenclature and collection start date.

Site-hazardous waste and contaminants found in refinery wastes and wastewater are listed in **Tables 6-4 and 6-5**.

6.9 ASBESTOS HAZARDS

There is a potential for asbestos exposure at these site; therefore, employees need to be aware of asbestos potential hazards. Once asbestos fibers are trapped in the body, the fibers can cause serious health hazards. The most common way for asbestos fibers to enter the body is through inhalation. If asbestos is disturbed during site activity employees will immediately evacuate the area and notify the appropriate client personnel.

There is a potential for asbestos exposure at this site; therefore, employees need to be aware of asbestos potential hazards. Once asbestos fibers are trapped in the body, the fibers can cause serious health hazards. The most common way for asbestos fibers to enter the body is through inhalation. If unplanned asbestos is disturbed during site activity employees will immediately evacuate the area and notify the appropriate client personnel. If soils that may have been mixed with asbestos are encountered, they will be kept adequately wet (sufficiently mixed or penetrated with water to completely prevent the release of particulate material into the ambient air), and workers will work upwind of activities.

Project team members should be familiar with each states expectation when working around and or conduction asbestos inspections. Below is a brief overview of asbestos expectations by State, project team should verify these expectations prior to working with or around asbestos within these states.

Colorado

- **Regulation 8**: Governs asbestos work in Colorado.
- **Certification**: Individuals must be certified by the Colorado Department of Public Health and Environment (CDPHE) to perform asbestos-related activities.
- **Disposal**: Specific regulations for the disposal of asbestos waste.

Montana

- **Asbestos Control Program**: Administered by the Montana Department of Environmental Quality (MDEQ).
- **Permits**: Required for renovation and demolition activities.
- **Training and Accreditation**: Mandatory Montana Asbestos training and accreditation for all asbestos-related occupations.

North Dakota

- **Emission Standards**: Enforced under the North Dakota Pollution Control Rules.
- **Certification**: Contractors and workers must be licensed and certified by the North Dakota Department of Environmental Quality (NDDEQ).

Pennsylvania

- **Asbestos Certification**: Required for all individuals involved in asbestos-related activities.
- **Regulations**: Governed by the Pennsylvania Department of Environmental Protection (PDEP).

Utah

- **Asbestos Program**: Administered by the Utah Department of Environmental Quality (UDEQ).
- **Permits and Training**: Required for asbestos abatement activities.

Wyoming

- **Asbestos Control**: Governed by the Wyoming Department of Environmental Quality (WDEQ).
- **Certification**: Required for contractors and workers involved in asbestos abatement.

Each state has its own specific regulations and requirements, so it's important to check with the respective state's environmental protection agency for detailed information.

Additional requirements under the OSHA's and each states OSHA's asbestos standards include training, exposure assessment, hazard communication (Signage), special work practices, medical surveillance, and recordkeeping.

OSHA's Asbestos Standard is an exposure-based standard, and as such, the regulations are not limited to only activities involving asbestos containing materials (ACM) that have greater than 1% asbestos, but materials with trace to 1% asbestos may also be subject to the OSHA standard if workplace air concentrations exceed the OSHA permissible exposure limit (PEL):

- The permissible exposure limit (PEL) is 0.1 f/cc of air, on an 8-hour time weighted average (TWA). TWA means exposure concentration averaged over an 8-hour period.
- An excursion limit (EL) of 1.0 f/cc, over a 30-minute TWA. This number is also known as a Short-Term Exposure Limit or STEL.

6.10 HYDROGEN SULFIDE (H_2S) HAZARDS

Hydrogen sulfide (also known as H_2S, sewer gas, swamp gas, stink damp, and sour damp) is a colorless gas known for its pungent "rotten egg" odor at low concentrations. It is extremely flammable and highly toxic. Hydrogen sulfide also occurs naturally in sewers, manure pits, well water, oil and gas wells, and volcanoes. Because it is heavier than air, hydrogen sulfide can collect in low-lying and enclosed spaces, such as manholes, sewers, and underground telephone vaults. Its presence makes work in confined spaces potentially very dangerous.

Project team members will be equipped with a meter that will monitor H_2S exposure where applicable.

Hydrocarbons containing H_2S are commonly called "sour". The following physical properties of H_2S gas include:

- Colorless and flammable
- Heavier than air
- Lighter than air if mixed with light hydrocarbons (i.e. Methane)
- Can occur as a vapor or dissolved in produced water, crude oil or condensate
- Can collect in confined spaces or in headspaces of tanks, pipes, and vessels containing sour fluids.

The health effects of hydrogen sulfide depend on how much H_2S a worker breathes and for how long. However, many effects are seen even at low concentrations. Effects range from mild, headaches or eye irritation, to very serious, unconsciousness and death. Common exposure levels and health effects are listed below and in **Table 5-2**:

Concentration (ppm)	Health Effect
0.01 - 0.3	Odor threshold
1 - 20	Offensive odor, possible nausea, tearing of the eyes or headaches with prolonged exposure
20 - 50	Nose, throat and lung irritation; digestive upset and loss of appetite; sense of smell starts to become fatigued; acute conjunctivitis may occur (pain, tearing and light sensitivity)
100 - 200	Severe nose, throat and lung irritation; ability to smell odor completely disappears.
250 - 500	Pulmonary edema (buildup of fluid in the lungs)
500	Severe lung irritation, excitement, headache, dizziness, staggering, sudden collapse (knockdown), unconsciousness and death within a few hours, loss of memory for the period of exposure
500 - 1000	Respiratory paralysis, irregular heartbeat, collapse and death without rescue.
> 1000	Rapid collapse and death

6.11 NATURAL DISASTERS

6.11.1 TORNADOS

If you are under a tornado WARNING, seek shelter immediately!

6.11.1.1 IF INDOORS

- Go to a pre-designated shelter area such as a safe room, basement, storm cellar, or the lowest building level.
- If there is no basement, go to the center of an interior room on the lowest level (closet, interior hallway) away from corners, windows, doors, and outside walls.
- Put as many walls as possible between you and the outside.
- Get under a sturdy table and use your arms to protect your head and neck. Do not open windows.

6.11.1.2 IF IN A VEHICLE, TRAILER, OR MOBILE HOME

- Get out immediately and go to the lowest floor of a sturdy, nearby building or a storm shelter. Mobile homes, even if tied down, offer little protection from tornadoes.

6.11.1.3 IF OUTDOORS WITH NO SHELTER

- Lie flat in a nearby ditch or depression and cover your head with your hands. Be aware of the potential for flooding.
- Do not get under an overpass or bridge; you are safer in a low, flat location.
- Never try to outrun a tornado in urban or congested areas in a car or truck. Instead, leave the vehicle immediately for safe shelter.
- Watch out for flying debris. Flying debris from tornadoes causes most fatalities and injuries.

6.12 CLIMATE HAZARDS

During day-to-day field work, on-site personnel will be alert for the signs and symptoms of climatic stress. Field team members will be observed for the following signs and symptoms of climatic stress:

- Change in body temperature
- Profuse sweating (or absence of sweating when sweating is expected)
- Skin color change
- Shivering
- Disorientation or slurring of speech
- Vision problems
- Muscle cramps or spasms

6.12.1 HEAT STRESS

Heat stress is the increased heart rate, body temperature, respiration, and perspiration that results when the body works to reduce unwanted heat.

6.12.1.1 HEAT STROKE

Heat stroke is the most serious level of heat stress and can be lethal. During heat stroke, moisture from sweat is not available to stimulate evaporative cooling. Some symptoms of heat stroke include:

- Extremely high body temperature
- Red, hot, dry skin (sweating is absent)
- Strong, rapid pulse
- Convulsions or collapse

- Delirium, disorientation, or unconsciousness

The most important emergency measures to take in the event of heat stroke are:

- Call for emergency help.
- Cool the victim rapidly; get the victim to a shaded area until emergency help is available.
- If the victim is conscious, administer liquids, but never give alcoholic beverages or stimulants such as coffee or tea.
- If emergency help is not available, seek medical attention during or immediately following the cooling process.

6.12.1.2 HEAT EXHAUSTION

Heat exhaustion is not as severe as heat stroke but can lead to heat stroke if not treated properly. Some symptoms of heat exhaustion include:

- Body temperature is normal or slightly deviant from normal
- Profuse sweating
- Pale, clammy skin
- Weak pulse
- Fatigue, dizziness or giddiness, fainting
- Muscle cramps
- Nausea or vomiting

The most important emergency measures to take in the event of heat exhaustion to prevent heat stroke are:

- Cool the victim in shade or indoors
- Have the victim lie down with feet slightly elevated
- Loosen clothing
- If conscious, administer an electrolyte solution, such as Gatorade, every 15 minutes unless vomiting occurs
- If symptoms persist or recur, seek medical attention

6.12.1.3 PREVENTION OF HEAT STRESS

The work schedule should be paced based on weather conditions. There should be adequate rest periods when electrolyte solutions are available, as it may be necessary to replace body fluids and electrolytes as often as every 15 minutes. Air thermometers and oral medical thermometers should be available.

Clothing should be light and reflective and a sunscreen with at least a sun protection factor (SPF) of 15 should cover areas of the body that are exposed to direct sunlight. In the case of perspiration, the sunscreen should be re-applied as necessary. It should be remembered that a thin layer of clouds is not a form of protection against sunburn, as ultraviolet rays penetrate thin cloud layers.

The effects of heat and humidity are shown in **Table 6-6**.

6.12.2 COLD STRESS

Cold stress is when the body's core temperature drops below 96.8°F (36°C). Cold stress occurs when the body is unable to compensate for excessive heat loss. Cold stress includes frostbite and hypothermia. Symptoms include pain in the extremities, mental confusion, tripping, and falling. This can occur in temperatures below 50°F, especially in people performing physical labor. Wind chill factor also needs to be taken into consideration (see the **Table 6-7**).

The most important emergency measures to take in the event of cold stress are:

- Individuals suffering from cold stress should move to a heated area.
- The outer layer of clothing should be removed, and the remainder of clothing loosened.
- Wet clothing should be replaced with dry clothing.
- The individual should be instructed to rest until the symptoms are no longer recognizable.
- If the symptoms appear critical, persist, or get worse, immediate medical attention will be sought.

6.12.2.1 FROSTBITE

Frostbite occurs when body parts freeze. Hands, feet, ears, nose, lips, cheeks, and chin are the most vulnerable to frostbite. There are three stages of frostbite: 1) shallow skin, 2) intermediate skin and underlying tissues, and 3) deep frostbite to the bone. The symptoms include:

- The skin changing from red to pale or waxy
- Tingling, stinging, and cold sensations
- Gradual numbness
- Deep frostbite has a cold, solid feel with pale color

First aid for frostbite includes:

- Move the person to a warm area. Put affected body parts in warm water (105 - 110 degrees F) until skin becomes flushed. Use of hotter water will result in additional damage.
- After warming, the injured area should be wrapped in sterile gauze, keeping affected fingers and toes separated.
- If you cannot guarantee that the tissue will stay warm, do not warm the tissue until it can be kept warm.
- If normal sensations haven't returned within 30 minutes, seek medical attention.
- ***DO NOT RUB OR MASSAGE!*** (Have the person move or exercise the affected areas as soon as possible).

6.12.2.2 HYPOTHERMIA

Hypothermia occurs when heat loss causes the body temperature to lower. Rapid warming is urgently needed to prevent death. The symptoms include:

- Severe shivering (shivering decreases as body temperature lowers)
- Disorientation
- An uncaring attitude
- Slower breathing
- Slow speech
- Forgetfulness
- Loss of manual dexterity
- Pupil dilation at 86°F body temperature
- Eventual unconsciousness and death at body temperatures of 80°F and lower

First aid for hypothermia includes:

- Rest in a warm, sheltered area
- If hypothermia advances beyond shivering, get immediate medical help
- Remove wet clothing and apply heat to the body
- Drink warm water and eat warm food if conscious

6.12.2.3 PREVENTION OF COLD STRESS

To prevent cold stress, wear layers of clothing to keep warm and dry and protect the head, hands, and feet from cold. The work rate should not be so high as to cause heavy sweating that will result in wet clothing. Cooling power of the wind is shown in **Table 6-7.**

6.13 ERGONOMIC HAZARDS

The interaction of personnel with their working environment at this site may present potential hazards, such as incorrect lifting of heavy loads, equipment vibrations, improper twisting, or improper body positioning. The aforementioned conditions are potential factors during site activities. Personnel should position themselves properly, lift with the legs when lifting equipment or heavy objects, and rely on the buddy system for assistance in lifting loads that are awkward or too heavy for one person. Back strain, the most common ergonomic hazard in the field, may be avoided if site workers ask for assistance when needed. It is expected that employees will seek assistance when lifting loads exceeding 50 pounds.

6.13.1 LIFTING PROCEDURES

Back injuries can happen as quickly as one wrong move. Lifting and carrying objects can be safer if:

- Plan the route before lifting the load and remove obstacles.
- When lifting items from below arm level, bend your knees, not your back, to lower your body to the object.
- Bring the load as close as possible to the body before lifting.
- Grip firmly with your hands (not just fingers) and keep your arms and elbows tucked in for more strength.
- Lift by letting your legs push you up, not your back.
- Check that you can see where you are going and move slowly enough to avoid bumping into other objects.
- Do not twist your body while carrying heavy objects; twisting is a major cause of injury. If you need to change directions, move your feet in that direction first.
- Lifting is safest when you keep your back straight and your stomach muscles tight. Staying in good physical condition and getting proper exercise are also important.

Loads should be broken down to movable weights, routes planned, and legs used to do the work. Help should be obtained, or a handcart or other device used if an object is too heavy.

6.14 ACOUSTICAL HAZARDS

When working around site equipment, the potential exists for team members to be exposed to noise levels above the OSHA exposure limit of 85 decibels on an 8-hour TWA. Trihydro and OSHA require the use of hearing protection when working in areas where the exposure limit is equal to or greater than 85 decibels on an 8-hour TWA. To provide adequate hearing protection, Trihydro team members should wear hearing protection while working around mechanical equipment on site. Field team personnel will not use headphones during work.

6.15 DUST HAZARDS

The generation of dust and fugitive emissions will be prevented when possible and controlled when necessary. Work practices may be adjusted in a manner to minimize dust generation. Personnel will avoid working in dust by positioning themselves upwind of intrusive activities. Hazardous dust will be controlled by suppression with water where it poses a risk to workers or community. Throughout site activities, dust areas should be watered, as needed, to minimize dust.

6.16 SILICA HAZARDS

Crystalline silica is a common mineral found in many naturally occurring and man-made materials used at project sites (e.g., sand, concrete, brick, block, stone, and mortar). Amorphous silica, (e.g., silica gel) is not crystalline silica. Respirable crystalline silica is generated by high-energy operations like cutting, sawing, grinding, drilling, and crushing stone, rock, concrete, brick, block and mortar, or during abrasive sand blasting.

Project team members should review each states Silica rules, **Pennsylvania** is known for having some of the strictest silica requirements. Pennsylvania's regulations align closely with the federal OSHA standards but often include additional state-specific provisions to ensure worker safety.

Breathing crystalline silica particles can causes diseases, including silicosis, an incurable lung disease that leads to disability and death. Respirable crystalline silica also causes lung cancer, chronic obstructive pulmonary disease (COPD), and kidney disease.

Silicosis typically occurs after 15 to 20 years of occupational exposure to respirable crystalline silica. The Occupational Safety and Health Administration (OSHA) Respirable Crystalline Silica standard for general industry and construction requires employers to limit worker exposures to respirable crystalline silica and take other precautionary steps to protect workers.

OSHA lists an occupational exposure limit (OEL) for respirable crystalline silica (including quartz) at 0.025 milligrams per cubic meter (mg/m3). This is a concentration to which workers could be exposed for 8 hours a day, 5 days a week, without adverse health effects. However, as a suspected carcinogen, crystalline silica is also an "As Low as Reasonably Achievable" (ALARA) substance, and exposures must be reduced to ALARA levels below the OEL. The OSHA Respirable Crystalline Silica Standards apply to all occupational exposures to Respirable Crystalline Silica work, except where employee exposure will remain below 25 micrograms of Respirable Crystalline Silica per cubic meter of air (25 µg/m3) as an 8-hour time-weighted average (TWA).

Trihydro uses various methods to assist with assessing possible and actual silica exposures. These methods include, but may not necessarily be limited to:

- Reviewing data/reports available in the public domain (i.e., information available through regulatory agencies and industry associations).
- Regularly consulting with safety resources/client safety managers from companies that perform similar work.
- Implementing a respirable silica exposure monitoring program. This program will check that (over time) Trihydro has quantifiable silica exposure data available that is representative of regularly occurring, as well as reasonably foreseeable work activities. Exposure monitoring will generally be conducted "in-house," although assistance (i.e., monitoring and/or interpretation of results) may be obtained through outside consultants.

When possible and applicable, Trihydro will conduct activities with potential silica exposure to be consistent with OSHA's Construction Standard Table 1. Project managers will check that each employee under their supervision and engaged in a task identified on OSHA's Construction Standard Table 1 (Included in Trihydro's CRYSTALLINE SILICA EXPOSURE CONTROL POLICY, PROGRAM & PROCEDURE) check exposure levels.

During project activities, teams will have fully and properly implemented the engineering controls, work practices, and respiratory protection specified for the task in Table 1 (unless Trihydro has assessed and limited employee exposure to Respirable Crystalline Silica in accordance with the Alternative Exposure Control Methods Section of this program). Engineering Control Methods including elimination wet methods, operator isolation, and personal protective equipment (PPE) will help project-team members stay safe.

6.16.1 WET METHODS

Wet-spray methods can greatly reduce silica exposure levels of team members and the general public who work near operations that may produce silica dust. Wet methods should use the following guidance:

- Locate nozzles upstream of dust generation points.
- Position nozzles to thoroughly wet the material.
- Check that the volume and size of droplets is adequate to sufficiently wet the material (optimal droplet size is between 10 and 150 µm).
- Ensure nozzles provide complete water coverage but are not so far that the water is carried away by wind.

6.16.2 OPERATOR ISOLATION

Operator isolation includes using either an enclosed booth or a remote-control station. Operators using machines with enclosed cabs can limit their silica exposure by staying inside the cab during operations. The enclosed cab must:

- Be well-sealed and well-ventilated using positive pressure.
- Have door jambs, window grooves, power-line entries and other joints that work properly and are tightly sealed.

6.16.3 RESPIRATORY PROTECTION

An air purifying respirator fitted with HEPA cartridges is the most common PPE provided and used by Trihydro to minimize exposure to silica dust. Depending on the effectiveness of other engineering control measures, either a "full-face piece" or "half-face piece" respirator will be used by personnel (most situations will require a half-face respirator). When working indoors or in other areas with poor ventilation, a full-face respirator may be required. Both respirators are "seal dependent," and thus the users must be "fit tested" and clean shaven where the respirator seals to the face.

6.17 EXCAVATION HAZARDS

Daily inspections of excavations will be made by a competent person as defined in the OSHA 29 CFR 1926.650 utilizing the Trihydro Daily Excavation and Trench Inspection Form.

6.17.1 COMPETENT PERSON

A competent person must be on site to do the following:

- Conduct inspections of the excavations, adjacent areas, and protective systems before the start of work; as needed throughout the shift; and daily for potential cave-ins, failures, hazardous atmospheres, or other hazards.
- Take prompt corrective action or remove employees from the hazard.
- The competent person must be able to demonstrate the following:

- The ability to recognize possible hazards associated with excavation work and to test for hazardous atmospheres
- Knowledge of the current safety orders pertaining to excavation and trenching
- The ability to analyze and classify soils
- Knowledge of the design and use of protective systems
- The authority and ability to take prompt corrective action when conditions change

6.17.2 EMERGENCY RESCUE EQUIPMENT

Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a lifeline securely attached to it. The lifeline shall be separate from any line used to handle materials and shall be individually attended at all times while the employee wearing the lifeline is in the excavation.

6.17.3 PROTECTION FROM UNDERGROUND UTILITIES

Before commencing excavation operations, the existence and location of underground pipes, electrical equipment, telephone, gas lines, etc. will be determined and documented.

6.17.4 PROTECTION FROM HAZARDOUS ATMOSPHERES

- For excavations greater than 4 feet in depth where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter.
- If flammable/combustible vapors reach or exceed 20% of the LEL, operations will be suspended, ignition sources eliminated, and the area will be ventilated if the concentration until the LEL is reduced below 10%. The project team will use a combustible gas meter to make this determination.

6.17.5 PROTECTION OF EMPLOYEES FROM LOOSE ROCK, SOIL, AND OBJECTS

- Personnel entry into excavations 5-feet deep or greater is only permitted if the necessary protective systems are in place using shoring methods or sloping and benching will be compliant with the OSHA CFR 1926 Subpart P, Appendix B.
- Excavations greater than 4-feet deep that require personnel to enter will have sufficient means of ingress and egress (stairs, ladders, ramps) within a maximum travel distance of 25 feet. If ladders are provided, they must be secured and extend at least 3 feet above grade.
- Excavations greater than 20 feet deep shall be designed by a registered professional engineer.
- Spoils will be placed at least 2 feet from the edge of the excavation or removed entirely.
- Objects will be kept a minimum distance of 2 feet from the edge.
- Where the stability of adjacent structures (buildings, walls, footers, foundations, or other structures) is endangered by excavation operations, a registered professional engineer shall determine the measures necessary to protect employees and the structure.

6.17.6 FALL PROTECTION

Where employees or equipment are required or permitted to cross over excavations over 6-feet deep, walkways or bridges with standard guardrails are to be provided.

Adequate physical barrier protection is to be provided at remotely located excavations. Wells, pits, shafts, etc., are to be barricaded or covered. Perimeter protection constructed of a physical barrier that prevents entry into the work zone placed at a distance not closer than 6 feet from the edge of the excavation and displays adequate warning. Upon completion of exploration and other similar operations, temporary wells, pits, shafts, etc., are to be backfilled.

6.17.7 PROTECTION FROM HAZARDS ASSOCIATED WITH WATER ACCUMULATION

Employees are not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

If water is controlled or prevented from accumulating by using water removal equipment, the water removal equipment and operations is to be monitored by a competent person to ensure proper operation.

6.17.8 STABILITY OF ADJACENT STRUCTURES

Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when:

- A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or
- The excavation is in stable rock; or
- A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

Sidewalks, pavements, and appurtenant structure is not to be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

6.17.9 ACCESS AND EGRESS

A stairway, ladder, ramp, or other safe means of egress is to be located in trench excavations that are 4 feet or more in depth so as to require no more than 25 feet of lateral travel for employees.

- Structural ramps that are used solely by employees as a means of access or egress from excavations are to be designed by a competent person. Structural ramps used for access or egress of equipment is be designed by a competent person qualified in structural design and is to be constructed in accordance with the design.
- Ramps and runways constructed of two or more structural members are to have the structural members connected together to prevent displacement.
- Structural members used for ramps and runways are to be of uniform thickness.
- Cleats or other appropriate means used to connect runway structural members are to be attached to the bottom of the runway or be attached in a manner to prevent tripping.
- Structural ramps used in lieu of steps are to be provided with cleats or other surface treatments to the top surface to prevent slipping.

6.17.10 EXPOSURE TO VEHICULAR TRAFFIC

Employees exposed to public vehicular traffic are to be provided with, and wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

6.17.11 EXPOSURE TO FALLING LOADS

Employees are to be permitted underneath loads handled by lifting or digging equipment. Employees are required to stand away from vehicles being loaded or unloaded to avoid being struck by spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped to provide adequate protection for the operator during loading and unloading operations.

6.17.12 WARNING SYSTEM FOR MOBILE EQUIPMENT

When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system such as barricades, hand or mechanical signals, or stop logs is to be used. If possible, the grade should be away from the excavation.

6.17.13 INSPECTION

Daily inspections of excavations, the adjacent areas, and protective systems are to be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. These inspections are only required when employee exposure can be reasonably anticipated (e.g., entry into excavation or working near edges).

- Before the start of work
- As needed throughout the shift
- After rainstorms or other hazard increasing occurrence

Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees are to be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

6.18 DRILLING ACTIVITIES

Before any subsurface activities, Trihydro employees involved will complete Trihydro's Subsurface Utility Location and Excavation best practices training. When performing hollow stem auger, flight auger, air rotary, casing hammer, mud rotary, sonic, or direct push drilling operations, the following applies:

6.18.1 GENERAL SAFETY AND EMERGENCY RESPONSE

- Before work is begun, including rig set up, a tailgate safety meeting, review of site-specific health and safety plan, and job hazard review must be conducted at the site.
- The job hazard analysis must be specific to the rig to be utilized.
- A first-aid kit must be available in an easily accessible area away from the drilling operation. Its location must be reviewed during the tailgate safety meeting.
- Work cannot be performed if lightning strikes are observed in the area.

6.18.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Minimum required PPE for drilling jobs includes hard hat, safety shoes with steel toes, safety glasses or goggles, gloves, and hearing protection.
- Appropriate PPE must be worn to prevent irritation or contamination of the skin when handling potentially contaminated articles and spoils.
- Hearing protection must be worn in the Exclusion Zone or when working within 20 feet of the operating rig.
- Secure loose clothing, hair wraps, strings on jackets and hoods, and shoelaces. Jewelry is not allowed to be worn. Eliminate protruding tools from tool belts.

6.18.3 EQUIPMENT SAFETY

- The drilling contractor will complete a checklist daily to verify equipment is in safe and operable condition. The checklist must be available on site for review.
- Rig controls and levers, including emergency shut-off, should be legibly labeled. Wherever possible, pinch points will be identified and labeled.
- Adequate cribbing must be in place under the leveling jacks and outriggers to prevent tip-over or sinking into unstable soil.

- Secure the rig when it is in position; set brakes and/or locks, chock wheels or tracks as conditions require.
- The Exclusion Zone must be marked with a continuous barrier where the potential for site visitation by the public or other pedestrians exists.
- The Exclusion Zone(s) should be large enough to safely accommodate workers and drilling equipment.
- Check for adequate overhead clearance before raising the mast. Work in proximity to overhead power lines must address risk of contact with lines.
- Travel with the mast of the drill rig in the raised or partially raised position is unauthorized.
- The drilling rig must be equipped with an operable emergency shut-off or "kill" switch. Persons working within the Exclusion Zone must know the location and operation of the emergency shut-off switch. The functionality of emergency shut-off switches must be tested at the start of each workday.
- Whip checks or anti-whip devices must be in place on pressurized hose lines.
- Augers, drill rods, or down-hole equipment must be cleaned when the drill rig is in neutral, the engine is idle, and the machinery has stopped rotating.
- Repair to rigs must be done by a person trained and qualified to perform the repair.
- Do not perform maintenance or refueling while the equipment is operating.
- Work must cease if cables or cable clamps become damaged or frayed.
- No body part is allowed within 12 inches of a turning auger.
- Broken or substandard equipment must not be brought to the site. Equipment that becomes broken must be tagged as such and must not be used.
- Equipment must not be used if guards are not in place.
- Work areas must be kept in a clean and orderly condition. Tools and equipment must be stored properly when not in use.
- A worker must not attempt to move a load unassisted if the weight and bulk exceeds the capability of the worker. Loads greater than 50 pounds must not be repeatedly moved by a single person.
- Vertical storage of drill rods and augers is not allowed unless the rig is specifically designed to accommodate this practice.

- Drilling rods and augers may not be removed in multiple sections. Drilling rods and augers must be broken down at each joint as they are removed from the hole. Manual tools must not be used in combination with powered rotation.

6.18.4 DRILL-SITE CLEARANCE

To protect buried utilities and exposing employees to the hazards associated with utility strikes, a summary of Trihydro's drill-site clearance procedure is listed below. Trihydro's *Excavation, Drilling and Utility Locating Checklist* will be used prior to drilling and/or geoprobing activities. Before any subsurface activities, Trihydro employees involved will complete Trihydro's Subsurface Utility Location and Excavation best practices training. Procedures may vary based on the Clients expectations, PM's assessment of the area, tasks, and geological makeup.

- The drilling contractor will contact the appropriate "Call Before You Dig" one-call notification center at least 2 business days before excavation and/or drilling work is scheduled to begin.
- Contractor will verify that "Call Before You Dig" locators mark their facilities in the designated drill site area or provide notification that they do not have facilities near the proposed drill area.
- Locations of known utility lines will be clearly marked (using electronic locating methods) at each proposed drill site.
- Trihydro will conduct a thorough review of available subsurface utility-location maps for each proposed drill site.
- If drilling activities are within the "tolerance zone" and/or areas outside the "tolerance zone" when required by the client, each location will be potholed to a depth below the utility zone using minimally intrusive potholing methods such as hand auger, air or hydro vacuum techniques. Each of the proposed drill sites will be potholed to a minimum diameter no less than that of the proposed borehole to be drilled.
- If environmental soil-quality samples are required within the "utility window," air vacuum to the desired sample depth and use a hand auger to retrieve the sample.
- Visually confirm that no buried utilities or other subsurface obstructions are present in each pothole to the maximum depth of the "utility window."
- If no buried utilities or other obstructions are encountered, the proposed drill site is "cleared" for drilling.
- Before raising the mast on the drilling rig at each location, look for overhead lines. A 20-feet minimum clearance shall be maintained from overhead power lines, or per the client's requirements, whichever is greater. If the appropriate clearance cannot be maintained, the power lines shall be de-energized. If impracticable, or infeasible, contact the Corporate H&S Team for guidance.

- During drilling activities, proceed slowly for the first 5 feet.
- Stop drilling activities if resistance is encountered.
- A copy of the Trihydro Standard Operation Procedure – Excavation Site Clearance can be obtained on the Trihydro Internal Webpage.

6.18.5 HOUSEKEEPING DURING DRILLING OPERATIONS

- Do not store or transport tools, materials, or supplies within or on the mast (derrick) of the drill rig.
- Pipe, drill rods, casing, augers, and similar drilling tools will be stacked on racks or sills in an orderly fashion to prevent spreading, rolling, or sliding.
- Penetration, or other driving hammers, will be placed at a safe location on the ground or secured to prevent movement when not in use.
- Controls, control linkages, warning and operation lights, and lenses should be stored free of oil, grease, and/or ice.
- Keep support vehicles, unnecessary equipment, and unnecessary personnel outside of the work zone.

6.19 TRAFFIC HAZARDS

6.19.1 DRIVING SAFETY

Driving safety is required to protect the field team personnel from work-related injuries and accidents. Compliance with site, local, state, and federal traffic laws is required. Workers should drive defensively by continually watching for hazardous conditions, understanding how to defend against them, and taking action in time to avoid problems. Keep eyes and attention on the road and others and adjust speed and driving to changing weather and traffic conditions.

- Trihydro employees who, as a part of their duties, operate vehicles on public roads will hold a valid, properly classed driver's license and possess an acceptable driving record.
- Only vehicles designed for off-road operations will be allowed to leave improved roads and then only within the manufacturer's guidelines and the vehicle's capabilities and limitations. When operating off trail, the use of a spotter will be used. If a spotter is not available, then a ground recon of the intended route will be conducted by the driver before driving the area.
- Avoid driving or parking vehicles in areas with high and dry vegetation where a vehicles muffler or catalytic converter could be an ignition source and cause a grass fire.

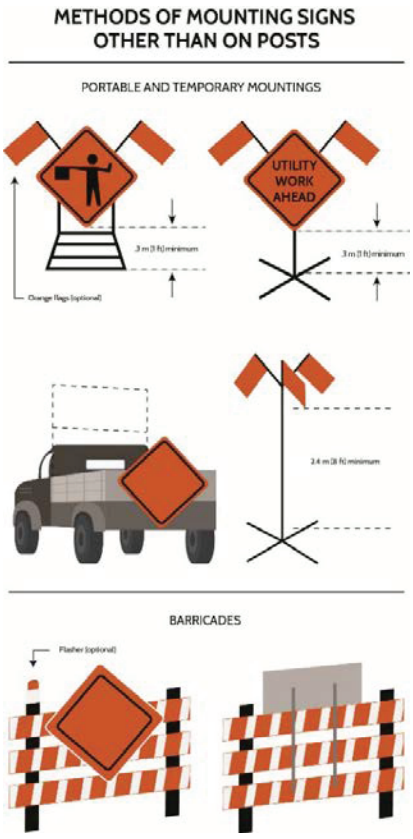
- Vehicles will be parked to allow the driver to pull forward to prevent the need for backing. If the vehicle needs to be backed, the driver will use a spotter or, in the absence of a spotter, perform a ground recon for obstacles before entering the vehicle and backing.
- Trihydro employees who, as a part of their duties drive corporate, rental vehicles, or personal vehicles for Trihydro business, will be 3-D Driving (defensive driving) certified before driving on corporate business. Refresher training is required every 2 years.
- Employees are expected to complete a Journey Assessment Form found on the Trihydro H&S Web site before departure when leaving their local area.
- Employees operating a vehicle, personal, rental, or fleet, on company business will not use a cell phone or other electronic device while operating the vehicle.
- Site workers are required to wear seat belts when operating or riding in vehicles.
- It is a violation of Trihydro's safety policy for employees to operate a vehicle with illegal drugs in his/her system or while impaired by alcohol, prescription drugs, or over-the-counter medications.
- Vehicles and other mobile equipment will operate within posted speed limits, and only in areas necessary to perform work, and will observe roadblocks and caution signs.
- Vehicles may be left running only for the purposes of operating auxiliary equipment or lights or for diesel engine warming, and then only when the driver can verify the vehicle is secure with the transmission in park or neutral, wheels chocked, and the parking brake set.
- Vehicles parked on sloped surfaces will have the transmission in park, or placed in first gear for manual transmissions, wheels chocked, and the parking brake set.
- When parking heavy equipment, such as front loaders and other excavation equipment, the driver will lower the buckets, blades, or other hydraulically driven attachments to the ground, place the vehicle in park, and set the parking brakes.
- Vehicle operators will not drive over unprotected hoses or exposed piping.
- Employees will enter and exit through the gates or pathway provided and designated for this use.
- Keys to unattended vehicles and equipment will be left in the ignition so the vehicles and equipment can be moved as necessary (on unsecured sites, this is at the discretion of the PM). Where applicable, vehicles and/or equipment are described as unattended anytime the driver is not at the controls of the vehicle.

- Upon notification of a release of flammable vapors, fire, or other immediate dangers, the operator will immediately shut down sources of ignition under his/her control. No attempt to start or move vehicles in the area will be made until conditions are safe for re-entry.

6.19.2 VEHICULAR SAFETY

The protection of project-team members from vehicular hazards while on site is crucial. The following actions should take place to provide a high level of protection from injuries caused by contact with vehicles and heavy equipment.

- Activities conducted in or near roadways or in parking lots not closed to traffic will be barricaded and guarded.
  - Backed up trucks and work vehicles can provide an effective barrier for worker protection in the work zone. Trucks should be positioned between the working area and the flow of traffic. Be sure to allow enough space between the vehicle and the closest workers to prevent the vehicle from being pushed into workers if it is hit.



- Traffic control devices will be installed before work begins in accordance with the U.S. Department of Transportation (USDOT) Manual on Uniform Traffic Control Devices (MUTCD), Chapter 6F, Temporary Traffic Control Zone Devices (http://mutcd.fhwa.dot.gov/htm/2003r1r2/part6/part6f1.htm).
  - The MUTCD defines traffic control devices as signs, signals, markings, and other devices used to regulate, warn, or guide road users, placed on, over, or adjacent to a street, highway, pedestrian facility, or bikeway.
  - Traffic control devices used on street and highway construction, maintenance, utility, or incident management operations will conform to the MUTCD.
  - Work site warning signs will be placed far enough from the work zone so that drivers will have time to read the messages and react before they reach the work area (see **Table 6-8**). On urban streets, the effective placement of the first warning sign should range from 4 to 8 times the speed limit with the high end of the range being used when speeds are relatively high. When a single advance warning sign is used (in cases such as low-speed residential streets), the advance warning area can be as short as 100 feet. When two or more advance warning signs are used on higher-speed streets, such as major arterials, the advance warning area should extend a greater distance. The distance from the work zone to the first sign is listed in column A. The distance from the first sign to the second is listed in

column B. The distance from the second sign to the third is listed in column C (The third sign is the first one in a three-sign series encountered by a driver approaching a TTC zone).

- Signs mounted on barricades, or other portable supports, will be no less than 1 foot above the traveled way.
- Traffic cones can be used to guide and direct traffic around or through the work areas during daylight hours. The devices will be installed before the work begins. At least one advance warning sign will be used to explain the cones. Flags inserted in the top of the cones increase their visibility.
- Backed up and stationery vehicles and trucks can also serve as warning devices when equipped with flashing high intensity emergency lights (a revolving light or strobe light above the cab).

- Work schedules should be adjust to avoid working in roadways and parking lot at dawn or dust or when drivers are blinded by the sun when practical.
- During sampling activities, one person should function as a flagger to divert traffic while another collects the samples.
- Flaggers and work crew will wear high visibility vests.
- Site heavy equipment will have backup warning devices.

6.19.3 POWERED INDUSTRIAL TRUCKS (FORKLIFTS, ETC.)

Powered industrial trucks includes fork trucks, tractors, platform lift trucks, motorized hand trucks, and other specialized industrial trucks powered by electric motors or internal combustion engines.

In accordance with OSHA CFR 1910.178(l), no employee is allowed to operate a powered industrial truck without receiving the proper training and certification. Refresher training is required every 3 years, when an employee is observed operating a powered industrial truck unsafely, an employee is operating a powered industrial truck and involved in an accident, the operator has received an evaluation that reveals that the operator is not operating the truck safely, the operator is assigned to drive a different type of truck, or a condition in the workplace changes in a manner that could affect safe operation of the truck.

6.20 CONTAMINATED SOIL REMOVAL/HAULING OPERATIONS

During contaminated soil removal operations, a *Contaminated Soil Removal Plan* will be developed, where relevant, to address the following issues and submitted to the client PM before work commencement:

- Dust/vapor control
- Excavation hazards
- Hazardous atmospheres
- Chemical hazards
- Traffic control
- Truck routing
- Utility clearance
- Asbestos hazards

6.21 CONFINED SPACE ENTRY

See Section 8.0.

6.22 BIOLOGICAL HAZARDS

6.22.1 BLOOD-BORNE PATHOGENS

Workers may be at risk of developing various types of illnesses, such as human immunodeficiency (HIV) and hepatitis B (HBV) and C (HCV) viruses, due to their exposure to blood-borne pathogens and other potentially infectious materials in the workplace.

Universal precautions, engineering, and work practice controls will be used to eliminate or minimize employee exposure. Universal precaution is the practice of treating bodily fluids as contaminated. Where occupational exposure remains after institution of these controls, PPE will also be used.
Trihydro will provide hand-washing facilities accessible to employees where feasible. When provision of hand-washing facilities is not feasible, Trihydro will provide an appropriate hand cleanser in conjunction with clean cloth/paper towels or antiseptic towelettes. When antiseptic cleansers or towelettes are used, hands will be washed with soap and running water as soon as feasible. Employees will wash their hands and other skin with soap and water, or flush mucous membranes with water immediately or as soon as feasible following contact of such body areas with blood or other potentially infectious materials.

Project sites will have on hand a blood-borne pathogen clean up kit and personnel should be trained before its use.

If field team members are exposed to body fluids, they will report the incident immediately to Trihydro's PM, who will fill out Trihydro's "Exposure Incident Report" found in **Appendix H**.

6.22.2 HANTAVIRUS

Hantavirus pulmonary syndrome (HPS) is a rare but serious, and often deadly, lung infection. Hantaviruses are found in rodents in different parts of the world where the Sin Nombre virus is carried by the deer mouse, the cotton rat, and perhaps other rodents common throughout North America. The Sin Nombre virus is passed to humans by saliva, urine, and droppings of infected rodents.

The best way to prevent HPS is to:

- Avoid contact with rodents and avoid inhaling dust that might be contaminated with rodent saliva, urine, or droppings.
- Use safety precautions when cleaning indoor or outdoor areas that might be contaminated with rodent saliva, urine, or droppings. Do not stir up and breathe dust. Before cleaning, wet down potentially contaminated areas with a disinfectant (such as bleach or alcohol). While cleaning, wear rubber gloves and disinfect them after use. Dust masks that cover the nose and mouth can also help.
- When participating in outside activities, stay clear of rodents and their burrows and nests. Open up and air out outbuildings before entering or cleaning. Remove garbage and trash before leaving.

6.22.3 HISTOPLASMOSIS

Although histoplasmosis is usually associated with bird and bat droppings, it actually is caused by a fungus. You can only get it by inhaling dust from decayed droppings or contaminated soil. Anyplace where bird or bat droppings have accumulated is a likely source of the “Histo” fungus. Prevention is the best solution for exposure.

- Avoid creating dust that will put the fungus in the air where it can be inhaled.
- Try not to disturb soil rich in bird droppings.
- When work requires the removal of contaminated soils, do so with wet sweeping and vacuuming with a high efficiency particulate air (HEPA) filter.
- Soil should be placed in heavy-duty plastic bags or other secure containers for disposal.

6.22.4 PSITTACOSIS

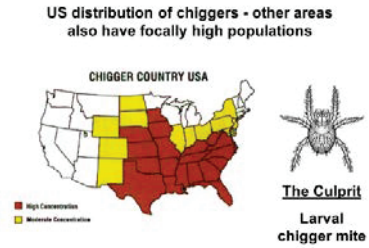
Psittacosis is an infectious disease in humans that has mild, non-specific, flu-like symptoms. Psittacosis refers to infections or diseases caused by Chlamydia psittaci, one of several microorganisms in the genus Chlamydia. This disease can be transmitted from infected birds, either wild or domestic birds or poultry, to humans.
Sick birds show signs of:

- Sleepiness
- Weight loss
- Diarrhea
- Shivering
- Breathing difficulties

Humans can become infected with Chlamydia psittaci by breathing in the organism when the urine, respiratory secretion, or dried feces of infected birds is aerosolized (i.e., dispersed in the air as very fine droplets or dust particles). Other sources of exposure include mouth-to-beak contact, a bite from an infected bird, and handling the plumage and tissues of infected birds.

6.22.5 CHIGGERS

Chiggers are most often found in low, damp areas where vegetation is heavy, although some species prefer dry areas. Chiggers seem to be most abundant in areas covered with shrubs and small trees where rodents are numerous. Chiggers occur in pockets or islands because a female will lay all her eggs in one spot. Chiggers may be a problem when working in grassy areas at project locations. The application of DEET can help prevent bites from these insects.



WARNING: Do not apply DEET on flame-resistant clothing (FRC); it makes the clothing flammable. Use Pyrethrin on FRC.

If a chigger bite is experienced, the bite should be washed with soap and water and then a commercial preparation of medication for chigger bites should be applied. The clothes that were worn when the bite(s) occurred should be placed in a plastic bag for temporary storage until they can be laundered.

6.22.6 STINGING INSECTS

Stinging insects are limited to the order Hymenoptera, which includes wasps, bees, and ants where only females can sting. Social hymenopterans, including yellow jackets, bumble bees, honeybees, and fire ants have individuals in the colony whose task it is to defend the nest. If the nest is disturbed, these individuals will defend it vigorously. In addition, foraging members of the colony will also sting if they are disturbed or injured as they go about their activities. Some, such as the yellow jacket, are much more liable to attack than others.

6.22.6.1 SINGLE STINGS

The body responds to the venom of stings with redness and swelling at the sting site. The area is quite likely to itch. Oral and topical antihistamines should help prevent or reduce itching and swelling. Try not to rub or scratch the sting site, because microbes from the surface of the skin could be introduced into the wound and result in an infection.

If the stinger remains in the skin, remove it as quickly as possible, because venom continues to enter the skin from the stinger for 45 to 60 seconds following a sting. If removed within 15 seconds of the sting, the severity of the sting is reduced. After the stinger is removed, wash the wound, and treat it with an over-the-counter product or simply a cold compress to alleviate the pain. Aerosol or cream antihistamine preparations that contain a skin coolant can also help. If the sting is followed by severe symptoms, or if it occurs on the neck or mouth, seek medical attention immediately because swelling in these areas of the body can cause suffocation.

6.22.6.2 MULTIPLE STINGS

Occasionally, a person becomes involved in a situation where he or she is stung many times before being able to flee. Humans can be killed if stung enough times in a single incident. Honeybees' toxic dose is estimated to be 8.6 stings per pound of body weight.

6.22.6.3 RENAL INSUFFICIENCY

A potentially life-threatening result of multiple stings may occur days after the incident where the kidneys become clogged and the patient is in danger of dying from kidney failure. It is important for persons who have received many stings at one time to discuss this secondary effect with their doctors. Patients should be monitored for a week or two following an incident involving multiple wasp or bee stings.

6.22.6.4 ANAPHYLAXIS

A small percentage of the population is allergic to wasp or bee stings. Allergic reactions to bee and wasp stings can develop anywhere on the body and may include non-life-threatening reactions such as hives, swelling, nausea, vomiting, abdominal cramps, and headaches. Life-threatening reactions such as shock, dizziness, unconsciousness, difficulty in breathing, and laryngeal blockage resulting from swelling in the throat require immediate medical care. Symptoms can begin immediately following the sting or up to 30 minutes later and may last for hours.

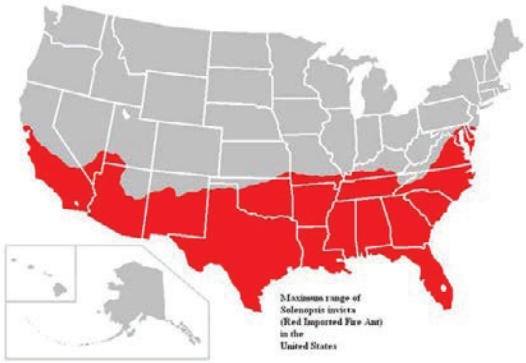
Anaphylaxis, if treated in time, usually can be reversed by the effects of epinephrine (adrenaline) injected into the body. Individuals who are aware that they are allergic to stings should notify the PM and carry epinephrine in either a normal syringe (sting kit) or in an auto-injector (Epi-Pen®) whenever they think they may encounter stinging insects.

6.22.7 FIRE ANTS

The red imported fire ant (RIFA) is an invasive species of insect. The ant is distinguished by its ten-segmented antennae, which have two-segmented clubs. The ants range from reddish-brown to dark brown in color and from 3 to 6 mm in length.

Human health problems arise as a result of people being stung by RIFA. RIFA stings usually result in the formation of a white pustule, which takes 10 days to heal. If the pustule ruptures before healing, the wound and surrounding area may become infected. Sensitive individuals may have an allergic reaction to the stings, perhaps resulting in anaphylactic shock or, in extreme cases, death.





6.22.8 LYME DISEASE/ ALPHA-GAL SYNDROME (TICKS)

Tick-borne pathogens present a significant field hazard and in some areas account for many serious field incidents. These procedures should be applied during field activities – even in areas that are predominantly paved but with bordering vegetation.

6.22.8.1 HAZARD CONTROL

The methods for controlling exposure to ticks include, in order of most preferred to least:

- Avoiding tick habitats and ceasing operations in heavily infested areas.
- Reducing tick abundance through habitat disruption or application of acaricide.
- Personal protection through the use of repellants and protective clothing.
- Frequent tick inspections and proper hygiene.

6.22.8.2 FIRST AID AND MEDICAL TREATMENT

Tick bites should be treated with first aid. Clean and wash hands and disinfect the bite site after removing embedded tick by use of tweezers. Consult a healthcare professional if infection or symptoms and effects of tick-borne illnesses develop ("target" or "bull's eye rash").

6.22.8.3 TICK IDENTIFICATION

There are four varieties of hard-bodied ticks that have been associated with tick-borne pathogens. These tick varieties include: American Dog Tick; Black-Legged (Deer) Tick; Lone Star Tick; and Rocky Mountain Wood Tick.

The following ticks can be considered a hazard at the site locations:



Rocky Mountain wood tick

LOCATION: Rocky Mountain states and southwestern Canada

SPREADS: Rocky Mountain spotted fever, Colorado tick fever and tularemia



American Dog Tick

LOCATION: East of the Rocky Mountains and in limited areas on the Pacific Coast

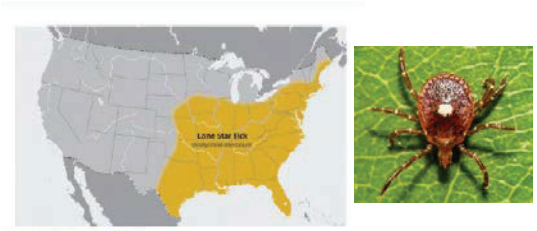
SPREADS: Tularemia and Rocky Mountain spotted fever



Blacklegged tick

LOCATION: Northeastern and upper Midwestern U.S.

SPREADS: Lyme disease, anaplasmosis, babesiosis and Powassan disease



Lone star tick

LOCATION: Southeastern and eastern U.S.

SPREADS: Ehrlichiosis, tularemia and STARI

Lone Star Tick can cause Alpha gal syndrome in some people bitten by the tick. Alpha gal syndrome is not a disease or infection but an allergy to a sugar molecule found in red meat. Individuals who develop alpha-gal syndrome, consuming red meat or any food with a meat product in it triggers an allergic reaction. Allergy symptoms can include hives, itching, eczema, swelling of the lips, face, tongue, and throat, wheezing; stomach upset, headaches, and anaphylaxis. Most food allergies happen almost immediately after exposure, but with alpha-gal syndrome, the allergic response to the problematic food takes between 2-6 hours to manifest.

More information on Alpha-Gal Syndrome is available here: Lone Star Tick - Alpha-Gal Syndrome.

6.22.9 WEST NILE VIRUS

The West Nile virus (WNV) is a virus transmitted by mosquitoes to other animals normally through a mosquito bite. The most likely route of WNV infection to humans is through the bite of an infected mosquito. It is recommended that workers use standard infection control precautions when working with humans or animals suspected of or known to be infected with WNV. Also follow standard infection control procedures when handling sick or dead animals.

Most human WNV infections cause either no symptoms or a mild, flu-like illness. The most severely affected patients may develop an inflammation of the brain called encephalitis. These severe cases are very rare in humans. Persons over age 50 are at higher risk of severe illness following infection.

6.22.1 VALLEY FEVER

Valley Fever is caused by a microscopic fungus found in the top 2 to 12 inches of soil. The fungal spores become airborne when soil and dust is disturbed by activities such as high winds, excavation, or other dirt-moving operations, and driving on dirt roads. When spores are inhaled, you can become infected. Although Valley Fever is not contagious, anyone can contract Valley Fever, with men and people with compromised immune systems at a higher risk.

Cases of Valley Fever (also known as *Coccidioidomycosis)* have been tracked in the Southwest states of Arizona, California, Nevada, New Mexico, Texas, and Utah. However, cases have also been found in the southeast and central Washington State (Burdick 2019).

Symptoms

Infected individuals may take from 1 to 4 weeks to show signs of Valley Fever. Signs may include:

- Fatigue
- Cough
- Chest pain
- Fever
- Rash
- Headache
- Joint aches
- Red bumps over the skin

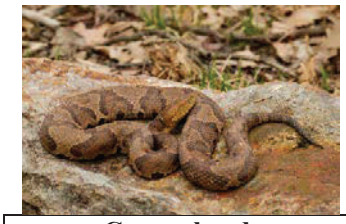
Prevention

While there is no vaccine for Valley Fever, the following steps can help reduce the risk of infection:

- Minimize the area of soil disturbed.
- Use water to reduce airborne dust.
- Stabilize spoils piles by tarping or other methods.
- Use air-conditioned vehicles while working in heavy dust areas; make sure windows are closed.
- Stop work during heavy wind periods.
- When exposure to dust is unavoidable, wear NIOSH-approved respiratory protection with particulate filters rated as N95, N99, N100, P100, or HEPA.

6.22.2 SNAKES

There are four common species of poisonous snakes in the United States: Copperhead, Coral Snake, Cottonmouth, and Rattle Snake. To see a list of snakes found in the project site states, **see Appendix I.**

			
Copperhead	**Coral Snake**	**Cottonmouth**	**Rattle Snake**
Chestnut color dominates overall, with darker crossbands of rich browns that become narrower on top and widen at the bottom. The top of the head is a coppery color. ***Eastern Gulf States, Texas, Arkansas, Maryland, North Florida, Illinois, Oklahoma, Kansas, Ohio, New York, Alabama, Tennessee, and Massachusetts.***	Beautifully marked with bright blacks, reds, and yellows. To identify the species, remember that when red touches yellow it is a coral snake. ***Southeast North Carolina, Gulf States, west central Mississippi, Florida, Florida Keys, and west to Texas. Another genus of coral snake is found in Arizona.***	Colors are variable. Adults are uniformly olive brown or black. The young and sub-adults are strongly cross banded with dark brown. ***All Gulf states, Southeast Virginia, west central Alabama, south Georgia, Illinois, east central Kentucky, south central Oklahoma, Texas, North and South Carolina, Florida, and the Florida Keys.***	2 types call the US home - the eastern and western diamondback. The Western Diamondback is shown and has a darker color. ***The western diamondback resides in Southeast California, Oklahoma, Texas, New Mexico, and Arizona while the eastern diamondback resides in Coastal areas of North Carolina, South Carolina, Louisiana & Florida***

6.22.2.1 PREVENTING SNAKE BITES

Follow these simple rules to reduce the chance of accidental snakebite:

- Do not put your hands into dark places, such as rock crevices, heavy brush, or hollow logs, without first investigating.
- Do not step over a fallen tree. Step on the log and look to see if there is a snake resting on the other side.
- Do not walk through heavy brush or tall grass without looking down. Look where you are walking.
- Wear snake gaiters – a thick wrap that protects the lower leg.

6.22.2.2 EMERGENCY RESPONSE

Venomous snake bites should be considered life-threatening. When someone has been bitten by a venomous snake, time is of the essence. If possible, call ahead to the emergency room so anti-venom can be ready when the victim arrives. Do the following:

- Seek medical help immediately by contacting WorkCare™ Incident Intervention for assistance at (888) 449-7787.
- Keep the victim calm, restrict movement, and keep the affected area below heart level to reduce the flow of venom.
- Remove rings or constricting items; the affected area will swell.
- Wash the bite area with soap and water.
- Cover the bite with clean, moist dressing to reduce swelling and discomfort.
- Monitor the vital signs (pulse, temperature, breathing, blood pressure) of the victim. If there are signs of shock, lay the victim flat and cover with a warm blanket.
- ***DO NOT*** apply a tourniquet.
- ***DO NOT*** apply a cold compress to the bite area.
- ***DO NOT*** cut into the bite.
- ***DO NOT*** give the victim stimulants or pain medications unless instructed by a medical physician.
- ***DO NOT*** give the victim anything by mouth.
- ***DO NOT*** raise the bite area above the level of the victim's heart.
- ***DO NOT*** try to suction the venom—doing so may cause more harm than good.

6.22.3 SPIDERS

Only a few spiders are dangerous to humans with the two problematic spiders in the United States being the Brown Recluse and Black Widow spiders. Bites from spiders may feel like a pinprick and may not even be noticed, but within hours, swelling at the site and breathing problems may occur. Emergency help should be immediately sought. A cloth dampened with cold water or filled with ice may be applied to the bite while awaiting help.

6.22.3.1 BROWN RECLUSE (LOXOSCELES RECLUSA)

It is usually between ¼ in and ¾ in, but may grow larger. It is brown and sometimes an almost deep yellow color and usually has markings on the dorsal side of its cephalothorax, with a black line coming from it that looks like a violin with the neck of the violin pointing to the rear of the spider, resulting in the nickname "fiddleback spider" or "violin spider". Coloring varies from light tan to brown and the violin marking may not be visible.





Most bites are minor with no necrosis (tissue damage). However, a small number of bites produce severe dermonecrotic lesions (skin tissue damage), and, sometimes, severe systemic symptoms, including organ damage. Rarely, the bite may also produce a systemic condition with occasional fatalities. A minority of brown recluse spider bites form a necrotizing ulcer that destroys soft tissue and may take months to heal, leaving deep scars.

First aid involves the application of an ice pack to control inflammation, the application of aloe vera to soothe and help control the pain, and prompt medical care.

6.22.3.2 BLACK WIDOW (LATRODECTUS SPP)

Adult female black widow spiders are gloss black with an hourglass shaped marking on the underside of its abdomen which is red and male black widow spiders' hourglass color is yellow to white to various shades of orange and red. A large female black widow spider can grow to about 1.5 inches, counting leg span. Male black widow spiders are half the size of the female or smaller (third picture from left). They have longer legs and a smaller abdomen in relation to their body size. They are also usually dark brown with varying colors of stripes/dots, with no hourglass mark. Adult

males can be distinguished from juvenile females by their more-slender body, longer legs, and large pedipalps (second pair of appendages) typical of most other male spiders.



Female Black Widow



Male Black Widow



Black Widow Nest

Although their venom is extremely potent, (15 times more potent than that of the rattlesnakes), these spiders are not especially large. When the venom is diffused throughout the body of a healthy, mature human, it usually does not amount to a fatal dose, though it can produce the very unpleasant symptoms of latrodectism (abdominal muscle pain and spasms). Deaths in healthy adults from Latrodectus bites are relatively rare.

6.22.4 POISON OAK/IVY/SUMAC

Reaction to poisonous shrubs is an allergic response and ranges from no reaction to a severe “rhus” dermatitis. Rhus is the class of poisonous plants which also includes poison ivy and poison sumac, mango, and other urushiol containing plants.

Shrubs are usually 12" to 30" high, or a tree-climbing vine, with triple leaflets and short, smooth hair underneath. Early berries are fuzzy and white; later, dun-colored. Plants are red and dark green in spring and summer with yellowing leaves anytime, especially in dry areas. Leaves may achieve bright reds in fall, but the plant loses its (yellowed, then brown) leaves in winter, leaving toxic stems. All parts of the plant remain toxic throughout the seasons.

Primary contamination results from contact with bruised or broken plant parts that release "toxicodendrol," an oily resin containing the toxic chemical "urushiol."



Poison Ivy



Poison Sumac



Poison Oak

The best way to prevent exposure is to recognize the plants and avoid working in areas where poisonous shrubs are present. If you will be working in areas with poisonous shrubs, contact your PSHSO to determine the best procedures to prevent contamination.

6.22.4.1 FIRST AID

If there is exposure, use the following first aid procedures or others you may find to alleviate the pain and itch.

- Keep your hands away from your eyes, mouth, and face
- Do not scratch or rub the rash
- Apply one of these to the skin rash:
  - Calamine (not Caladryl) lotion
  - Zinc oxide ointment
  - Paste made with baking soda - mix 3 teaspoons of baking soda with 1 teaspoon of water
- Take an over-the-counter antihistamine such as Benadryl, as stated on the label

If self-care/first aid measures do not bring relief, or for extreme cases of exposure, contact your doctor.

7.0 DECONTAMINATION PROCEDURES

As a tenant on a True Companies site, an evaluation was conducted to determine the potential for hazardous substance contamination during Trihydro tasks at this site. That evaluation indicates that ***there is no potential*** of contamination of a sufficient quantity to require decontamination planning, equipment, and procedures outlined in 29 CFR 1910.120. For that reason, no decontamination program is implemented at this site. Employee training on how to respond and take protective measures during incidental releases of hazardous substances are provided consistent with the Hazard Communication Standard, 29 CFR 1910.1200.

8.0 CONFINED SPACE ENTRY PROCEDURES

Confined spaces ("non-permit confined space") are defined as meeting ***all of the following***:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit.
- Is not designed for continuous employee occupancy.

Some True Companies sites may view certain boating operations as confined spaces; coordinate with a client site representative before conducting boating activities.

A Permit Required Confined Space ("permit space") is defined as a confined space that has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere that is defined as:
  - Having flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL).
  - An airborne combustible dust at a concentration that meets or exceeds its LFL.
  - An atmospheric oxygen concentration below 19.5 percent or above 23.5 percent.
  - An atmospheric concentration of substances for which could result in employee exposure in excess of its dose or permissible exposure limit.
  - Other atmospheric condition that is immediately dangerous to life or health.
- Contains a material that has the potential for engulfing an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains other recognized serious safety or health hazard.

Any project work requiring confined space activities performed by Trihydro or a Trihydro sub will get preapproval from the project Business Unit Leader and Trihydro Health & Safety Manager. Confined spaces are initially considered "permit required" until an evaluation is conducted using the Trihydro "Work-Area Evaluation for Confined Spaces **(Appendix F)**." No individual is allowed to enter a confined space, serve as an attendant outside of a confined space, or other confined space duties without proper training. Workers planning on entering or overseeing confined space activities must first determine if the activity being conducted falls under the OSHA General Industry or

Construction industry regulations and determine what regulatory requirements apply. Construction activities 20 CFR 1926 includes new construction, repair to existing facility, and replacement of an existing structure or any of its components. (Maintenance is generally not considered construction). Monitoring and taking samples would generally fall under the general industry standard 20 CFR 1910.146. Training requirements can be found in the Occupational Safety and Health Administrative CFR 1910.146(g) for OSHA General Industry and Occupational Safety and Health Administrative CFR 1926.1207 for Construction.

8.1 CONFINED SPACE OPERATIONS

Confined space operations require:

- Initial evaluation to determine if the space is a permit-required confined space
- Barricades to prevent unauthorized entry and to eliminate fall hazards
- Objects will be kept away from the opening edge to prevent falling object hazards

8.2 PERMIT-REQUIRED CONFINED SPACE OPERATIONS

In addition, permit-required confined space operations require:

- Coordination with the client site administrative and emergency response personnel.
- Identify and evaluate hazards.
- Develop and implement the means, procedures, and practices necessary for safe permit space entry operations.
- Verify appropriate training for those conducting permit-required confined space operations.
- Complete line-breaking, blanking, or lockout/tag out.
- Complete a permit and maintain required documentation at the permit space to include authorized entrant logs. The client's permit has precedence over the Trihydro permit.
- Perform atmospheric testing.
- Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards.
- Provide the attendant with air monitoring equipment.
- Provide pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards.
- Verify conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

- Verify rescue services are available and current on annual training. If rescue services respond to another site, the permit-required confined space operations will cease until rescue services has been re-established.
- Establish adequate communications with rescue services and entrants.
- Provide emergency rescue equipment if not provided by rescue services.
- Providing appropriate PPE.
- Provide adequate illumination.
- Provide equipment for safe entry and egress.

Upon completion of permit-required confined space operations, staff will be accounted for, permit space entrances will be properly closed, the client and rescue services notified, and the permit and associated documentation completed and kept on file for 1 year.

9.0 SPILL CONTAINMENT PROGRAM

9.1 RESULTS OF EVALUATION FOR POTENTIAL SPILLS

As a tenant on the client site, an evaluation was conducted to determine there is a potential for hazardous substance spills of Trihydro hazardous materials at this site. That evaluation indicates that ***there is no potential for a hazardous substance spill of a sufficient quantity*** to require containment planning, equipment, and procedures.

TABLES

TABLE 4-1. CRITERIA FOR SELECTION OF PERSONAL PROTECTION LEVEL

Protection Level	Equipment	Protection Provided	Should Be Used When	Limiting Criteria
A*	***RECOMMENDED:*** ▪ Pressure demand, full facepiece SCBA or pressure demand supplied air respirator with escape SCBA ▪ Fully encapsulating chemical-resistant suit ▪ Inner chemical-resistant gloves ▪ Chemical resistant safety boots/shoes ▪ Two way radio communications ***OPTIONAL:*** ▪ Cooling unit ▪ Coveralls ▪ Long cotton underwear ▪ Hard hat ▪ Disposable gloves and boot covers	The highest available level of respiratory, skin, and eye protection.	The chemical substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either: 1. Measured (or potential for) high concentration of atmospheric vapors, gases, or particles Or 2. Site operations and work functions involving a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the intact skin. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible. Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection is determined.	Fully encapsulating suit material must be compatible with the substances involved.

*Level A and B Protection Levels require prior approval by Trihydro's President before conducting Level A and B work activities.

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TABLE 4-1. CRITERIA FOR SELECTION OF PERSONAL PROTECTION LEVEL (cont.)

Protection Level	Equipment	Protection Provided	Should Be Used When	Limiting Criteria
B*	***RECOMMENDED:*** ▪ Pressure demand, full facepiece SCBA or pressure demand supplied air respirator with escape SCBA ▪ Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical resistant one piece suit) ▪ Inner and outer chemical resistant gloves ▪ Chemical resistant safety-boots/shoes ▪ Hard hat ▪ Two way radio communication ***OPTIONAL:*** ▪ Coveralls ▪ Disposable boot covers ▪ Face shield ▪ Long cotton underwear	The same level of respiratory protection but less skin protection than Level A. It is the minimum level recommended for initial site entries until the hazards have been further identified.	The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection. This involves atmospheres: 1. With IDLH concentrations of specific substances that do not represent a severe skin hazard Or 2. Do not meet the criteria for use of air-purifying respirators ▪ Atmosphere contains less than 19.5 percent oxygen. ▪ Presence of incompletely identified vapors or gases is indicated by direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin.	Use only when the vapor or gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin. Use only when it is highly unlikely that the work being done will generate either high concentrations of vapors, gases, or particulates, or splashes of material that will affect exposed skin.

*Level A and B Protection Levels require prior approval by Trihydro's President before conducting Level A and B work activities.

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TABLE 4-1. CRITERIA FOR SELECTION OF PERSONAL PROTECTION LEVEL (cont.)

Protection Level	Equipment	Protection Provided	Should Be Used When	Limiting Criteria
C	***RECOMMENDED:*** ▪ Full facepiece, air purifying, canister-equipped respirator ▪ Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical resistant one piece suit) ▪ Inner and outer chemical resistant gloves ▪ Chemical resistant safety boots/shoes ▪ Hard hat ▪ Two way radio communication ***OPTIONAL:*** ▪ Coveralls ▪ Disposable boot covers ▪ Face shield ▪ Escape mask ▪ Long cotton underwear	The same level of skin protection as Level B, but a lower level of respiratory protection.	The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin. The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant. All criteria for the use of air-purifying respirators are met.	Atmospheric concentration of chemicals must not exceed IDLH levels The atmosphere must contain at least 19.5 percent oxygen
D	***RECOMMENDED:*** ▪ Coveralls ▪ Safety boot/shoes ▪ Safety glasses or chemical splash goggles ▪ Hard hat ***OPTIONAL:*** ▪ Gloves ▪ Escape mask ▪ Face shield	No respiratory protection Minimal skin protection.	The atmosphere contains no known hazard Work functions preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemicals.	This level should not be used in the exclusive Zone. The atmosphere must contain at least 19.5 percent oxygen.

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TABLE 4-2. PERSONAL PROTECTIVE EQUIPMENT (PPE) SELECTION

Task	Personnel	Respirator	Tyvek Coveralls[1]	Protective Gloves	Chemical-Resistant Gloves[2]	Chemical-Resistant Boots[2]	Safety Glasses	Chemical Goggles or Face Shield[3]	Ear Plugs/ Muffs	Hard Hat[4]
Excavation and Drilling Operations in Contaminated Soils	Contractor Crew	Available for use	Yes[5]	Industrial Work Gloves	Yes	Yes	Yes	Available for use	Yes	Yes
	Engineer/ Chemist	Available for use	Available for use	Industrial Work Gloves	Available for use	Yes	Yes	Available for use	Yes	Yes
	Surveyors	Available for use	Available for use	Industrial Work Gloves	Available for use	Yes	Yes	Available for use	Yes	Yes
Decontamination Operations	Sampling Team	Available for use	Available for use	Industrial Work Gloves	Yes	Yes	Yes	Available for use	Yes	Yes
Soil, Gas, and Liquid Sampling	Sampling Team	Available for use	Available for use	Industrial Work Gloves, Laceration-proof	Available for use	Available for use	Yes	Available for use	Available for use	Yes
LDAR	Sampling Team	Available for use	Available for use	Industrial Work Gloves	Available for use	No	Yes	Available for use	Yes	Yes

[1] For chemical splash hazards
[2] Not required if soil or water is not visibly contaminated, if PID measurements of the soil samples are below 1000 ppm, and if pH measurements are between 2 and 12 standard units.
[3] For chemical splash hazards or flying debris. Face shield over safety glasses may be used in lieu of chemical goggles; however, safety glasses must be worn in conjunction with the face shield for flying debris.
[4] If falling-objects or head-impact hazards exist.
[5] Coveralls are to be taped to gloves and boots to minimize exposure pathways to contaminants.

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TABLE 4-3. RESPIRATOR ASSIGNED PROTECTION FACTOR (APF)

Assigned Protection Factors[5]					
Respirator Type[1,2]	**Quarter Mask**	**Half Mask**	**Full Face**	**Helmet/Hood**	**Loose-Fitting**
Air Purifying	5	10[3]	10/50[4]	----------	----------
PAPR	----------	50[4]	50[4]	25[4]	25[4]
SAR					
• Negative Pressure (Demand)	----------	10	50	----------	----------
• Continuous Flow	----------	50	50	25[4]	----------
• Pressure Demand	----------	1,000	2,000	----------	----------
• Pressure Demand with auxiliary pressure-demand SCBA (Escape Tank)	----------	----------	10,000	----------	----------
SCBA					
• Negative Pressure (Demand)	----------	----------	50	----------	----------
• Pressure Demand	----------	----------	10,000	----------	----------

[1] May use respirators assigned for higher concentrations in lower concentrations or when required use is independent of concentration.

[2] These APFs are only effective when employer has a continuing, effective respirator program per 1910.134.

[3] This APF category includes filtering face pieces and elastomeric face pieces.

[4] With appropriate gas/vapor cartridge and N-100, R-110, or P-100 filters.

[5] These APFs do not apply to escape-only respirators.

Negative Pressure Respirator: A tight-fitting respirator in which the air pressure inside the face piece is negative during inhalation with respect to the ambient air pressure outside the respirator.

Demand Respirator: A respirator in which the pressure inside the face piece in relation to the immediate environment is positive during exhalation and negative during inhalation.

Pressure Demand Respirator: A respirator in which the pressure inside the face piece in relation to the immediate environment is positive during both inhalation and exhalation.

Continuous Flow: A respirator that maintains air flow at all times, rather than only on demand. However, it may not maintain positive pressure within the mask at all times. Negative pressure conditions may occur during inhalation involving strenuous activity.

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TABLE 5-1. PID ORGANIC VAPOR ACTION LEVELS AND RESPONSES

Purpose

This table lists air monitoring action levels to be used in the field during direct measurement of total organic vapors (TOV) in the breathing zone using a photo ionization detector (PID) to determine Permissible Exposure Limits (PEL), and describes the responses required when action levels are exceeded. PID action levels for Trihydro projects fall under two categories: petroleum hydrocarbon sites, or chlorinated hydrocarbon sites. Separate action level tables are available for each of these site categories. The table for petroleum hydrocarbon sites lists action levels based on benzene exposure limits, and the table for chlorinated hydrocarbon sites lists action levels based on vinyl chloride exposure limits.

For reference, the occupational exposure limits used in establishing action levels in the tables below include Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL), OSHA Short Term Exposure Limits (STEL) or ceiling limits, and National Institute of Occupational Safety and Health (NIOSH) Immediate Danger to Life and Health (IDLH) concentrations. In addition, OSHA's 1910.1017, vinyl chloride standard, was referenced for the chlorinated hydrocarbon graph and table. Correction factors used to calculate action levels were taken from RAE Systems Technical Note TN-106, rev 13d, wh.01-05.

If both tables apply to a particular site, the lower of the two exposure limits will be used.

Notes for tables:

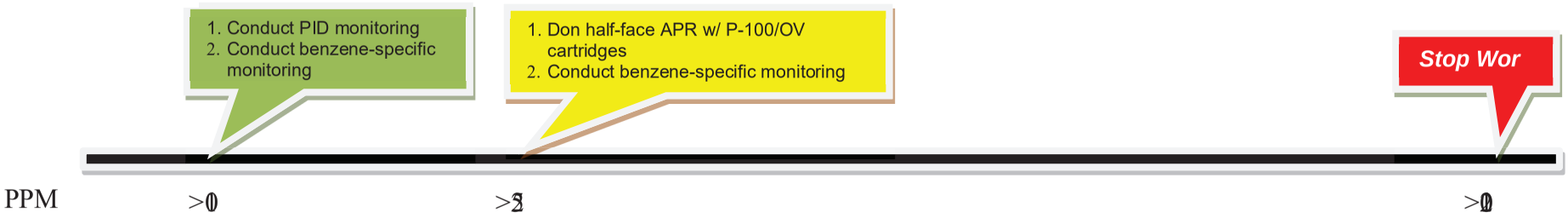
1. PID = Photo ionization detector
2. Benzene to be measured using colorimetric detector tubes or benzene-specific direct reading instrument (such as UltraRAE), vinyl chloride to be measured using colorimetric detector tubes
3. APR = Air purifying respirator
4. P-100/OV = Particulate rated filter P-100/organic vapor combination respirator cartridges

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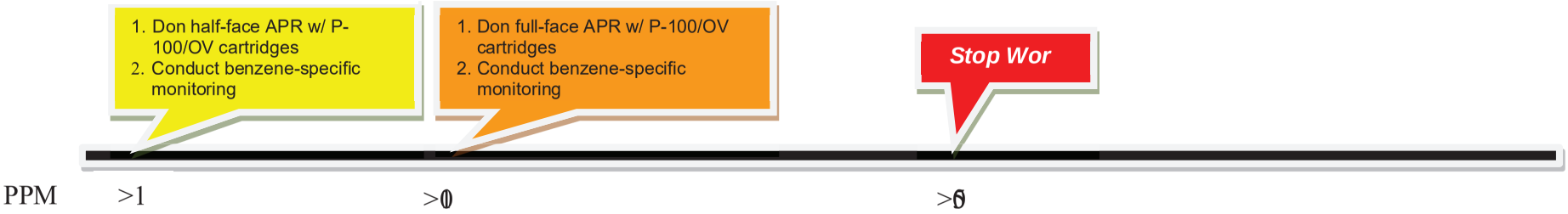
Summary Graph, PID Action Levels, Petroleum Hydrocarbon Sites (10.6 eV Lamp calibrated with 100 ppm isobutylene)

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PID Reading



Benzene Tube/Meter Results



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PID Action Levels, Petroleum Hydrocarbon Sites (10.6 eV Lamp calibrated with 100 ppm isobutylene)

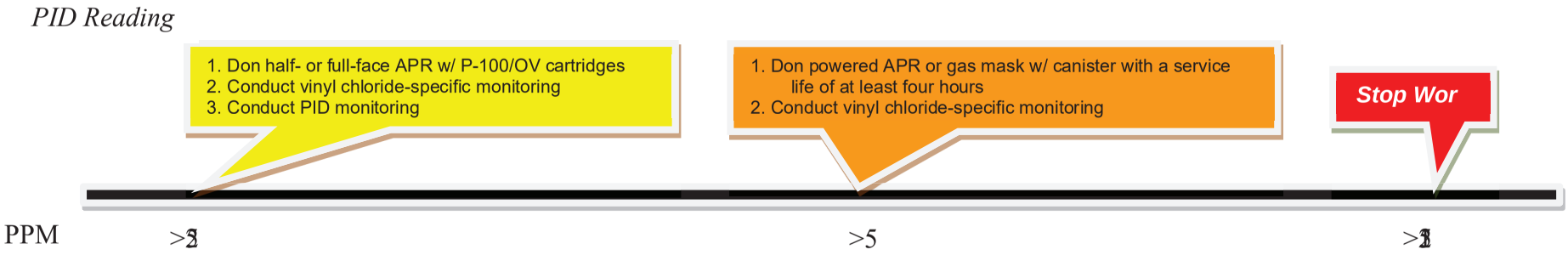
10.6 eV Lamp calibrated with 100 ppm isobutylene span gas
Reference: Benzene STEL of 5 ppm, IDLH of 500 ppm, and correction factor of 0.53

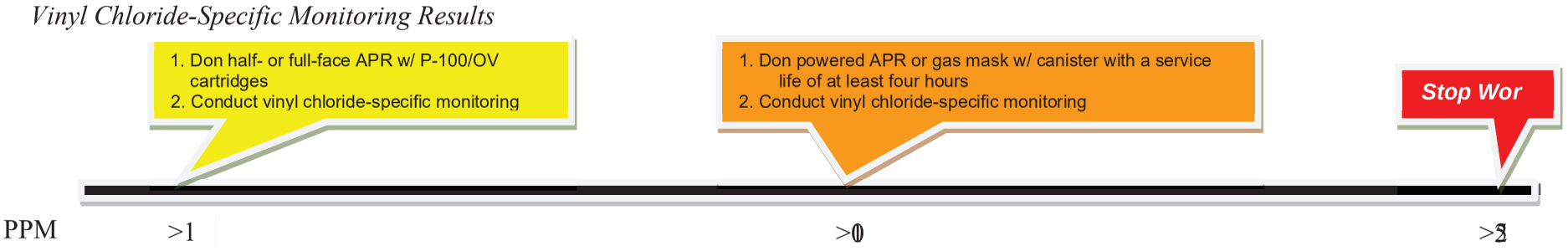
PID[1] Reading (ppm)	Duration of Reading	Action(s)
0 to 10	5 minutes sustained	Conduct PID monitoring
>10 to 25	5 minutes sustained	1. Conduct PID monitoring 2. Conduct periodic benzene-specific monitoring[2] a. Benzene >1 to 10 ppm – don ½ face APR[3] with P-100/OV cartridges[4]
>25 to 120	5 minutes sustained	1. Don ½ face APR with P-100/OV cartridges 2. Conduct PID monitoring 3. Conduct periodic benzene-specific monitoring[2] a. Benzene below 1 ppm – doff APR b. Benzene >1 to 10 ppm – maintain ½ face APR with P-100/OV cartridges c. Benzene >10 to 50 ppm – don full face APR with P-100/OV cartridges d. Benzene >50 ppm – stop work and evacuate area; notify Trihydro H&S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring
>120	1 minute sustained	1. Stop work and evacuate area 2. Notify Trihydro H&S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring

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Summary Graph, PID Action Levels, Chlorinated Hydrocarbon (10.6 eV Lamp calibrated with 100 ppm isobutylene)

ased n viny ride ei in 5 and rre i n a r 2 0





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PID Action Levels and Responses: Chlorinated Hydrocarbon Sites
10.6 eV Lamp calibrated with 100 ppm isobutylene span gas

Reference: Vinyl chloride Ceiling of 5 ppm, and correction factor of 2.0.

PID[1] Reading (ppm)	Duration of Reading	Action(s)
0 to 0.5	5 minutes sustained	Conduct PID monitoring
>0.5 to 2.5	5 min sustained	1. Conduct PID monitoring 2. Conduct periodic vinyl chloride-specific monitoring[2] a. Vinyl chloride >1 to 10 ppm – don half- or full-face APR[3] with P-100/OV cartridges[4]
>2.5 to 5	5 min sustained	1. Don half- or full-face APR with P-100/OV cartridges 2. Conduct PID monitoring 3. Conduct periodic vinyl chloride-specific monitoring[2] a. Vinyl chloride below 1 ppm – doff APR b. Vinyl chloride >1 to 10 ppm – maintain half- or full-face APR with P-100/OV cartridges c. Vinyl chloride >10 to 25 ppm – don a powered air-purifying respirator (APAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours. d. Vinyl chloride >25 ppm – stop work and evacuate area; notify Trihydro H&S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring
>5 to 12.5	5 min sustained	1. Don a powered air-purifying respirator (PAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours. 2. Conduct PID monitoring 3. Conduct periodic vinyl chloride-specific monitoring[2] a. Vinyl chloride below 1 ppm – doff APR b. Vinyl chloride >1 to 10 ppm – maintain half- or full-face APR with P-100/OV cartridges c. Vinyl chloride >10 to 25 ppm – maintain a powered air-purifying respirator (PAPR) having a hood, helmet, or full- or half-face piece, or a gas mask with a front-or back-mounted canister with a service life of at least four hours. d. Vinyl chloride >25 ppm – stop work and evacuate area; notify Trihydro H&S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring
>12.5	1 minute sustained	1. Stop work and evacuate area 2. Notify Trihydro H&S Team to discuss engineering controls, atmosphere-supplied respirators, and/or additional monitoring

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TABLE 5-2. HYDROGEN SULFIDE ACTION LEVELS

Hydrogen Sulfide Detector Reading	Action
10 ppm	Investigate the source and attempt to eliminate
15 ppm	Evacuate the area, determine the source, attempt to eliminate
20 ppm	Do not enter

TABLE 6-1. PROTECTIVE GLOVE GUIDE

Protection	Glove Material	Applications
Lacerations	Dyneema®, Kevlar®, fiber-metal blends, metal mesh, SuperFabric®, steel core, and Vectran	Cut-resistance: designed to protect hands from direct or indirect contact with sharp edges such as glass, metal, ceramics, and other materials. Many cut resistant gloves are manufactured to provide protection from a *SLASH* from sharp items like knives/blades. However, they may provide very little, if any, puncture-resistance from a pointed item like a needle, unless specifically designed for puncture resistance.
Needle Stick	HEX ARMOR®, DAMASCUS V-Force™ X4	Puncture protection. Ideal for correctional facility pat-downs/searches, customs officers, federal/state/city/municipal/university employees, luggage searches, hospital laundry and sharps handling.
Vibrations	DECADE® Gelfom™, AirGlove™	Provides padding at the palm, fingers, and thumb to help neutralize the force of heavy impacts, reducing the chance of injury.
Extreme high temperatures	Best® CharGuard™, ZETEX®, Kevlar®, Nomex®, Crusader Flex®, thermal knit, Terry Cloth, heavy weight cotton	For intermittent handling of hot objects. Ideal for hot castings for intermittent heat, lab sampling with hot glassware or moldings, plastic molding manufacturing, plant maintenance controls. Temperature protection ranges vary.
Extreme low temperatures	Best® Snow Man™, thermal knit, Terry Cloth, heavy weight cotton	For intermittent handling of hot objects.
Awareness	High visibility	Protective gloves made of a high visibility color help enhance hand position awareness; the color of the gloves is rotated on a quarterly basis. This prevents complacency for a particular color and can improve attentiveness.
Chemical	Butyl	A synthetic rubber material that offers the highest permeation resistance to gas and water vapors. Especially suited for use with esters and ketones.
	Neoprene	A synthetic rubber material that provides excellent tensile strength and heat resistance. Neoprene is compatible with some acids and caustics. It has moderate abrasion resistance.
	Nitrile	A synthetic rubber material that offers chemical and abrasion resistance—a very good general-duty glove. Nitrile also provides protection from oils, greases, petroleum products and some acids and caustics.
	PVC (Polyvinyl chloride)	A synthetic thermoplastic polymer that provides excellent resistance to most acids, fats, and petroleum hydrocarbons. Good abrasion resistance.
	PVA (Polyvinyl alcohol)	A water-soluble synthetic material that is highly impermeable to gases. Excellent chemical resistance to aromatic and chlorinated solvents. This glove cannot be used in water or water-based solutions.
	Viton®	A fluoroelastomer material that provides exceptional chemical resistance to chlorinated and aromatic solvents. Viton is very flexible but has minimal resistance to cuts and abrasions.
	SilverShield®/4H	A lightweight, flexible laminated material that resists permeation from a wide range of toxic and hazardous chemicals. It offers the highest level of overall chemical resistance but has virtually no cut resistance.

TABLE 6-2. ENERGIZED POWER LINE CLEARANCE

Task	Minimum Clearance Between Equipment and Energized Lines
Heavy equipment in transit with no load and boom lowered for overhead power lines with voltages less than 50, 000 volts	4’
Heavy equipment in transit with no load and boom lowered for overhead power lines with voltages over 50, 000 volts	10’
Heavy equipment in transit with no load and boom lowered for overhead power lines with for voltages up to and including 750,000 volts	16’
Setup/operations near overhead power lines up to 50,000 volts	10’
Setup/operations near overhead power lines over 50,000 volts	10’ plus 0.4 inches for each additional 1,000 volts over 50,000 volts
Drilling operations	20’

TABLE 6-3. EXPOSURE LIMITS FOR SITE CHEMICALS OF CONCERN

	OSHA Permissible Exposure Levels (PEL)			
Chemical	**TWA[1]**	**STEL[2]**	**Ceiling[3]**	**IDLH[4]**
Benzene (vapor)	1 ppm	5 ppm		500 ppm
Toluene (vapor)	200 ppm	300 ppm		500 ppm
Ethyl benzene (vapor)	100 ppm			800 ppm
Xylene (vapor)	100 ppm			900 ppm
Diesel (vapor)	None			
Gasoline (vapor)	None			

† Considered to be a potential occupational carcinogen.
[1]Time Weighted Average (TWA) concentrations for OSHA PELs must not be exceeded during any 8-hour work shift of a 40-hour workweek.
[2]A Short Term Exposure Limit (STEL) is measured over a 15-minute period unless noted otherwise.
[3]OSHA ceiling concentrations must not be exceeded during any part of the workday.
[4]Immediately Dangerous to Life and Health (IDLH) conditions are those that pose an immediate threat to life or health, or conditions that pose an immediate threat of severe exposure to contaminants, such as radioactive materials, which are likely to have adverse cumulative or delayed effects on health.

TABLE 6-4. LIST OF SITE HAZARDOUS WASTE

Chemical	Location(s)

TABLE 6-5. CHEMICAL CONTAMINANTS IN REFINERY WASTES AND WASTEWATER

Metals
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Lead
Mercury
Nickel
Selenium
Vanadium
Volatiles
Benzene
Carbon disulfide
Chlorobenzene
Chloroform
1,2-Dichloroethane
1,4-Dioxane
Ethylbenzene
Ethylene dibromide (1,2-Dibromoethane)
methyl ethyl ketone
Styrene
Toluene
Xylene (m, o, and p)
Semi-Volatile Base/Neutral Extractable Compounds
Anthracene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(a)pyrene
Bis(2-ethylhexyl)phthalate
Butyl benzyl phthalate
Chrysene
Cyclohexane
Dibenz(a,h)acridine
Dibenz(a,h)anthracene
Di(n)butyl phthalate
Dichlorobenzenes
Diethyl phthalate
7,12-Dimethylbenz(a)-anthracene
Dimethyl phthalate
Di(n)octyl phthalate
Fluoranthene
Indene
Methyl chrysene
2-Methylnaphthalene
Naphthalene
Phenanthrene
Pyrene
Pyridine
Quinoline
Semi-Volatile Acid-Extractable Compounds
Benzenethiol
Cresols
2,4-Dimethylphenol
2,4-Dinitrophenol
4-Nitrophenol
Phenol
Acidic/Caustic Compounds
Hydrofluoric acid
Sodium hydroxide
Sulfuric acid

* This list (with the exception of the acidic/alkaline compounds) is commonly referred to as the "Modified Skinner List," and was developed by the U.S. Environmental Protection Agency and American Petroleum Institute

TABLE 6-6. HEAT INDEX CHART

Heat index (HI) is sometimes referred to as the "apparent temperature." The HI, given in degrees F, is a measure of how hot it feels when relative humidity (RH) is added to the actual air temperature.

HEAT INDEX °F													
	RELATIVE HUMIDITY (%)												
Temp.	40	45	50	55	60	65	70	75	80	85	90	95	100
110	**136**												
108	**130**	**137**											
106	124	**130**	**137**										
104	119	124	**131**	**137**									
102	114	119	124	**130**	**137**								
100	109	114	118	124	129	**136**							
98	105	109	113	117	123	128	**134**						
96	101	104	108	112	116	121	126	**132**					
94	97	100	103	106	110	114	119	124	129	**135**			
92	94	96	99	101	105	108	112	116	121	126	**131**		
90	91	93	95	97	100	103	106	109	113	117	122	127	**132**
88	88	89	91	93	95	98	100	103	106	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

Category	Heat Index	Possible heat disorders for people in high risk groups
Extreme Danger	**130°F or higher**	**Heat stroke or sunstroke likely.**
Danger	105 - 129°F	Sunstroke, muscle cramps, and/or heat exhaustion likely. Heatstroke possible with prolonged exposure and/or physical activity.
Extreme Caution	90 - 105°F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Caution	80 - 90°F	Fatigue possible with prolonged exposure and/or physical activity.

Reference: NOAA's National Weather Service, 08/25/2023, https://www.wpc.ncep.noaa.gov/html/heatindex.shtml

TABLE 6-7. WIND CHILL CHART

LOW TEMPERATURE + WIND SPEED + WETNESS = INJURIES AND ILLNESS

Wind Speed	Ambient Temperature (F°)																	
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98
							Frostbite occurs in 15 minutes or less											

Reference: NOAA's National Weather Service, 09/20/2023 https://www.noaa.gov/jetstream/synoptic/wind-chill

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TABLE 6-8. TRAFFIC-CONTROL SIGN PLACEMENT

Road Type	Distance Between Signs (Feet)		
	A	B	C
Urban (low speed)*	100	100	100
Urban (high speed)*	350	350	350
Rural	500	500	500
Expressway/Freeway	1,000	1,500	2,640

* Speed category to be determined by highway agency

APPENDIX A

NEAR MISS REPORT

NEAR MISS REPORT

Trihydro

Please fill in ***all*** blanks with as much detail as possible. If you have any questions or need assistance, contact Trihydro Corporate Health and Safety at (307) 745-7474. Send completed form via email or FAX to (307) 460-7428

General Information

Near Miss Date: _____ Time: _____ ☐ AM ☐ PM

Reported Date: _____ Time: _____ ☐ AM ☐ PM

Work Type: _____

Project Client: _____ Project Manager: _____

Project Site: _____ Project Number: _____

Investigation Date: _____ Time: _____ ☐ AM ☐ PM

Supervisor: _____

Supervisor's employer and email if not employed by Trihydro Corporation: _____

Worker: _____ Time at Present Job: _____

Worker's employer and email if not employed by Trihydro Corporation: _____

Employee Status: ☐ Full Time ☐ Part Time

Near Miss Location: _____ _____ _____

Street *City* *State/Zip*

Near Miss Information

Employee's Specific Activities: _____

Near Miss Report

Equipment, Materials, or Chemicals Used: _____

_____

_____

Near Miss Description: _____

_____

_____

_____

_____

_____

_____

Near Miss Reported to: _____

Weather: ☐ Clear ☐ Cloudy ☐ Cyclonic ☐ Dusty ☐ Partly Cloudy ☐ Ice ☐ Hail ☐ Indoor ☐ Windy

☐ Mist ☐ Lightning ☐ Overcast ☐ Fog ☐ Hazy ☐ Rain ☐ Sleet ☐ Snow ☐ Thunderstorm

Lighting: ☐ Dawn ☐ Day ☐ Dusk ☐ Indoor ☐ Night

Witness #1 ☐ Client Employee ☐ Trihydro Employee ☐ Contractor: *(Company)* _____

Name: _____ Telephone No: _____

Witness #2 ☐ Client Employee ☐ Trihydro Employee ☐ Contractor: *(Company)* _____

Name: _____ Telephone No: _____

Witness #3 ☐ Client Employee ☐ Trihydro Employee ☐ Contractor: *(Company)* _____

Name: _____ Telephone No: _____

Witness #4 ☐ Client Employee ☐ Trihydro Employee ☐ Contractor: *(Company)* _____

Name: _____ Telephone No: _____

Cause Analysis

Root Cause Analysis (RCA) Table			
1	Lack of skill or knowledge	5	Doing the job according to procedures or acceptable practices take more time/effort
2	Lack of or inadequate operational procedures	6	Short-cutting procedures or acceptable practices is reinforced or tolerated
3	Inadequate communication of expectations regarding procedures or acceptable practices	7	In the past, did not follow procedures or acceptable practices and no incident occurred (injury, product quality incident, equipment damage, regulatory assessment, or production delay)
4	Inadequate tools or equipment	8	External factors

CF No.	RCA No.	Contributing Factors (CF) (Any factors that contributed to the near miss, but not the root cause):
1		
2		
3		
4		
5		
6		
7		
8		

**(Refer to RCA table)*

Corrective Actions

Immediate Actions Taken:

CF No.	Solution(s)	Responsible Person	Due Date	Completed
1				☐
2				☐
3				☐
4				☐
5				☐
6				☐
7				☐

Validation

Results of Solution, Verification, and Validation:

Investigation Team: _____

Primary Contact: _____ Telephone: _____

Reviewed By: _____ _____ _____

Name *Position/Title* *Date*

APPENDIX B

ACCIDENT/INCIDENT INVESTIGATION REPORT

ACCIDENT/INCIDENT REPORTING FORM

Trihydro

General Information

Incident Type: ***Incident*** ☐ ***Near Miss*** ☐

Primary Incident Type: ***Injury/Illness*** ☐ ***Motor Vehicle Accident*** ☐ ***Property / Equipment Damage*** ☐ ***Environmental*** ☐ ***Exposure*** ☐ ***Other*** ☐

Occurrence Date: _____ Occurrence Time: _____ ☐ AM ☐ PM

Date Reported: _____ Time Reported _____ ☐ AM ☐ PM

Reported By: _____ Telephone: _____

Occurrence Location: _____ On Site: ☐ Off Site: ☐

Stop Work Involved: ***Yes*** ☐ ***No*** ☐ SSE Involved: ***Yes*** ☐ ***No*** ☐

Police Notified: ***N/A*** ☐ ***Yes*** ☐ ***No*** ☐

Transportation to medical facility: ***N/A*** ☐ ***Yes*** ☐ ***No*** ☐

If yes, provide the following Facility Name: _____

Medical treatment received: ***N/A*** ☐ ***Yes*** ☐ ***No*** ☐

Description of Incident: _____

Individuals involved (Company Employee, Subcontractor Employee, Client Employee, Member of the Public, Witnesses)

Name	*Organization*	*Title*	*Telephone*

Vehicle Incident Details:

Check any that apply: ***Company Vehicle Involved*** ☐ ***Non-Company Vehicle Involved*** ☐

Vehicle Information: Vehicle #: _____ Vehicle VIN: _____

License Plate #: _____ Vehicle Make/Model: _____

Vehicle Year _____ Vehicle Color: _____

If Rental Vehicle, Rental Company: _____

of Passengers: _____ Names: _____

Driver Information First Name: _____ Last Name: _____

Address: _____

City _____ State: _____ Zip Code: _____

Phone # 1: _____ Phone # 2: _____

License Plate #: _____ Vehicle VIN: _____

Vehicle Year _____ Vehicle Make/Model: _____

Vehicle Color: _____ Driver License #: _____

of Passengers: _____ Names: _____

Insurance Company: _____ Phone: _____

Insurance Agent: _____ Phone: _____

Policy # _____ Exp. Date: _____

Details: Weather: Clear ☐ Rain ☐ Fog ☐ Wind ☐ Other ☐

Road Condition: Clear ☐ Wet ☐ Icy ☐ Debris ☐ Other ☐

Light Condition: Dawn ☐ Day: ☐ Dusk ☐ Dark ☐

Estimated Speeds _____ _____

Attending Police: Office Name: _____ Badge #: _____

Division: _____ Phone # _____

Tow Truck Operator: Company: _____ Phone #: _____

Drivers Name: _____

Address Towed To: _____

Citation Issued: ***Yes*** ☐ ***No*** ☐

Diagram: include streets, traffic controls, visual obstacles, etc.



Environmental/Exposure Incident Details:

Agent: Chemical/Substance ☐ Explosion ☐ Noise ☐ Radiation ☐ Vibration ☐

Medium: Air ☐ Soil ☐ Ground Water ☐ Surface Water ☐

Effect On: People ☐ Vegetation ☐ Animals ☐ Structures ☐ Equipment ☐ Materials ☐

Substance Information:

Name of Substance	Amount	Unit of Measure

PPE Worn: ***Yes*** ☐ ***No*** ☐

List PPE: _____

Response Details:

_____

_____

_____

_____

With any incident/accident:

Initial Notifications must be made to:

- Police, Ambulance, 911 (if applicable)
- H&S Team
- Risk Management
- Project Manager (PM)
- Supervisor
- Client (as directed by the PM)
- Site Managers (as directed by the PM)

If medical treatment is needed:

- Contact WorkCare at (888) 449-7787

Coordinate drug/alcohol testing within 3 hours

Complete the Accident/Incident Reporting Form and requested investigation items for submittal to the H&S Team.

Fax to H&S at (307) 460-7428

Enter into SPOT following the investigation

If after hours, contact the Safety Response number at (307) 755-4888.

Incident/Accident Timeline

Date	Time	Item

WITNESS FORM

Name of Witness	Job Title/Employer	Address of Employer
Telephone Number(s)	E-Mail Address(es)	Incident Date
Work: Cellular:		

1. Describe what the witness saw, heard, felt and/or smelled prior and during the incident/accident.
2. Fully describe the work and conditions in progress leading up to the event.
3. Did the witness note anything unusual prior to or during the incident/accident? If yes, what?
4. How did people or conditions influenced the incident/accident? (Actions, response, weather, time of day, etc.).
5. How does the witness think the incident/accident could have been prevented/additional comments?

Print Witness Name: _____ ***Date:*** _____

Witness Signature: _____ ***Time:*** _____

APPENDIX C

JOB SAFETY ANALYSIS (JSA) FORMS

JOB SAFETY ANALYSIS

Trihydro

JSA Version Date: May 1, 2014		
Job Description: Contaminated Soil Clean-Up (Excavation)		
Project: True Companies	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Michelle Harper	Geologist	307-745-7474
2.		
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kathy Brown	Project Manager	5/21/2014
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☒ Hard Hat	☒ Reflective Safety Vest	☒ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☒ Ear Plugs	☐ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☒ Industrial Work Gloves	☐ Sunscreen	☐ Ammonia Cartridge
☒ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☒ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☒ Equipment Decontamination	
☒ *Other:* First aid kit	☐ Personnel Decontamination	☐ *Other:*
☒ *Other:* Fire extinguisher	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Set up at work site			X		A. Overhead and/or underground utilities that can be encountered during excavation activities causing injury to personnel and/or damage to equipment and property.	A. Notify One-Call (811) at least 48 hours prior to excavation. Utilize local site contacts with utilities for private lines. All utilities should be physically marked. Prior to excavation Trihydro workers will complete subsurface utility locate and excavation best practices class.	
2. Excavation equipment			X		A. Malfunctioning or damaged equipment could cause and accident or incident	A. Require the subcontractor to conduct and document equipment inspection prior to each day of use. B. Review pertinent operating information with subcontractor (i.e. hand signals, site traffic flow, kill switches, etc.). Emergency kill switches will be labeled and tested. Review COP excavation guidelines and complete the excavation checklist.	
3. Excavation of contaminated soils		X			A. Exposure to contaminated soil or vapors. B. Heavy equipment hazards from pinch points, swinging arms, and moving equipment. C. Excavation/trench side wall collapse. D. Slip, trip, fall hazards.	A. Wear appropriate PPE, perform air and breathing zone monitoring, wear a respirator if necessary. B. Maintain safe work distance from operating heaving equipment. Maintain eye contact with operators at all times No personnel are permitted to stand underneath suspended loads. C. Excavations or trenches should not be entered unless side wall protection if in place and/or it has been certified as safe by an excavating competent person. If possible, perform tasks without entering the excavation or trench. No not enter an excavation or trench of 4 feet or greater in depth unless you have been confined space trained. Conduct daily excavation inspections and after significant weather events. Backfill excavations as soon as possible and fence off any area at the end of the work day that is left open. D. Maintain at least 3 feet distance from the edge of the excavation. Stockpile soils at least 2 feet from edge of excavation. E. Maintain work area to minimize clutter.	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
4. Collection of soil samples		X X X		 X	A. Slips, trips, fall hazards B. Heavy equipment hazards from pinch points, swinging arms, and moving equipment C. Exposure to contaminated soil.	A. Wear appropriate PPE, perform air and breathing zone monitoring, wear a respirator if necessary. B. Maintain safe work distance from operating heaving equipment. Maintain eye contact with operators at all times No personnel are permitted to stand underneath suspended loads. C. Excavations or trenches should not be entered unless side wall protection if in place and/or it has been certified as safe by an excavating competent person. If possible, perform tasks without entering the excavation or trench. No not enter an excavation or trench of 4 feet or greater in depth unless you have been confined space trained. Conduct daily excavation inspections and after significant weather events. Backfill excavations as soon as possible and fence off any area at the end of the work day that is left open. D. Maintain at least 3 feet distance from the edge of the excavation. Stockpile soils at least 2 feet from edge of excavation. E. Maintain work area to minimize clutter.	
5. Backfill		X X		 X	A. Slips, trip, fall hazards. B. Sidewall collapse. C. Heavy equipment hazards from pinch points, swinging arms, and moving equipment	A. Maintain safe work distance from operating heaving equipment. Maintain eye contact with operators at all times No personnel are permitted to stand underneath suspended loads.	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
						B. Excavations or trenches should not be entered unless side wall protection if in place and/or it has been certified as safe by an excavating competent person. If possible, perform tasks without entering the excavation or trench. No not enter an excavation or trench of 4 feet or greater in depth unless you have been confined space trained. Conduct daily excavation inspections and after significant weather events. Backfill excavations as soon as possible and fence off any area at the end of the work day that is left open. C. Maintain at least 3 feet distance from the edge of the excavation. Stockpile soils at least 2 feet from edge of excavation. D. Maintain work area to minimize clutter.	
6. Equipment decontamination					A. Transfer of contaminants	A. Thoroughly decontaminate non-dedicated PPE and equipment in the designated area after use. B. Dispose of PPE properly after use.	



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

JSA Version Date: August 15, 2017		
Job Description: Contractor Oversight		
Project: True Companies	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Ty LeMaitre	Geologist	307-745-7474
2. Brandon Ruckman	Engineer	307-745-7474
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kathy Brown	Project Manager	8/15/2017
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☒ Hard Hat	☒ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☒ Ear Plugs	☐ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☒ Industrial Work Gloves	☒ Sunscreen	☐ Ammonia Cartridge
☒ Chemical Resistant Gloves	☒ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☐ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)						Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Work planning							A. None	A. Work with contractor to plan work for appropriate conditions (e.g., weather, light, traffic, etc.) that will allow for safe completion of the work. Confirm that appropriate equipment will be onsite for the work to be performed.	
2. Utility locates			X				A. Utility contact during excavation or drilling	A. Confirm that the contractor has contacted One Call of Wyoming, and that utilities have responded. Check for the presence of private utilities (e.g., fuel lines and tanks, sewer, water, etc.) and work with property owners to locate them.	
3. Equipment operation		X				X	A. Slips/trips/falls B. Traffic hazards C. Equipment operation	A. Be aware of wet or icy surfaces, watch for mud, soil, and uneven surfaces. B. Confirm that the contractor's traffic control measures are adequate, wear orange vest, and stay away from traffic areas if possible. C. Stay outside of the range or motion of the equipment, unless you have eye contact and acknowledgement of the operator. Don't move near equipment without operator's knowledge. Wear hard hat, orange vest, and hearing protection if necessary. Be aware of tight working clearances. Use spotters when necessary.	
4. Trenching			X			X	A. Excavation hazards B. Trench hazards C. Slips/trips/falls D. Chemical exposure	A. Confirm utility locates, confirm that the equipment operator works carefully around utilities. B. Walk carefully near trenches. Do not enter trenches unless they are properly protected, or less than 4 feet deep in stable soil. Stay back from trench walls with the potential to collapse.	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
						C. Be aware of surface conditions such as snow, ice, water, mud, and soil. Keep tools and equipment off the ground or out of walkways. D. Stand upwind of work area.	



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

JSA Version Date: 04/12/2018		
Job Description: Monitoring of Components Identified as Difficult to Monitor (DTM)		
Project: True Companies	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Kyle Haag	Project Manager	(701) 290-4272
2.		
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kyle Haag	Project Manager	(701) 290-4272
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☒ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
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☒ Industrial Work Gloves	☐ Sunscreen	☐ Ammonia Cartridge
☐ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☐ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☒ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☒ *Other:* H2S Monitor
☐ *Other:*	☐ *Other:*	☒ *Other:* Required equip. for unit

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Entering the Unit – Prior to Entry					1) Chemical and physical hazards associated with the unit to be monitored. 2) Noise/Slip/Trip/Fall hazard 3) Chemical hazards including H2S 4) Planning	1) Prior to entering the unit you should be familiar with the operation to be monitored and review the PSM2 information provided by the facility as well as understand the appropriate evacuation routes. 2) Physical hazards – High noise levels, walking surfaces, maintenance work in the area, low hanging equipment, etc. These physical hazards should be discussed with the operators of the unit prior to unit entry. Check with operator on what other type of work is being conducted in the area that would impair our work. Review fall protection tie off locations for area to be monitored. Consult with unit operations regarding the use of appropriate equipment (man lifts, ladders, etc.) 3) Chemical hazards – LDAR monitoring is looking for VOC leaks, thus, it is anticipated that hydrocarbon materials will be encountered. Additionally, common non-hydrocarbon chemicals that can be encountered are H2S, sulfuric acid, ammonia, caustic, and hydrochloric acid. Appropriate PPE should be selected based upon the potential chemical hazards to be encountered. 4) Unit PSM information should be reviewed prior to unit entry. Obtain permits as appropriate.	
				X			
				X			
		X		X			
2. Unit entry – entering the unit.				X	1) Chemical and physical hazards associated with the unit to be monitored.	1A) Follow the facility unit entry procedures. 1B) Discuss prior to unit entry any work or changes that have occurred within the unit that monitoring personnel should be aware of prior to entering the unit. Verify the appropriate PPE for the unit. Obtain any appropriate work permits required for the unit or the facility.	
		X		X			
				X			
		X		X			

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
3. Inspecting in process unit.		X		X X	1) High noise levels, heights, temperature (heat or cold from process or insulation), electric shock, and ergonomic hazards	1A) Always wear appropriate hearing protection when working in operating process units. 1B) Prior to proceeding to height or monitoring location, review equipment that will be used to reach destination. Follow the appropriate site procedures for the piece of equipment (e.g. ladders, scaffolding, manlifts) 1C) Prior to proceeding monitor the surrounding area for physical hazards – close equipment, temperature, insulation, etc.	
4. Inspecting in process unit.		X		X X X	1) High noise levels, heights, temperature (heat or cold from process or insulation), electric shock, and ergonomic hazards	1) When in the units at elevation, ensure that the appropriate life line attachments are in place. Be observant of surrounds as insulation may be loose or equipment may not support weight. Be aware of temperature hazards – wear gloves. Be aware of changes in the conditions in the units due to weather – slick surfaces, wind, etc. Be aware of tight locations and ergonomic hazards. Watch working surfaces (roll hazards).	
5. Inspecting in process unit at elevation		X		X X	1) Ladder use and fall protection	1A) Follow the facility procedures for working at elevation. 1B) If fall protection must be used, inspect and monitor the equipment per the specific Trihydro and facility requirements. 1C) When using portable ladders, follow the facility procedures for inspection and securing the ladders and use appropriate angles. 1D) When climbing ladders, use three points of contact and take the time to safely climb the ladder. 1E) If other manlift equipment is being utilized, follow the appropriate safety procedures as outlined in the Trihydro and facility safety procedures. Check with operations when using aerial equipment on what type of permit is required (hot work or vehicle entry). 1F) If scaffolding is used, verify the safety policies and procedures are being followed. Ensure that the appropriate inspections and tags are in place prior to using the scaffold.	

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
6. Leaving the Unit – Breaks, Lunch, or at the End of Monitoring Shift		1) Potential changes in the condition or activities in the unit that might present a new hazard.	1A) Follow the facility's procedures for leaving the unit. 1B) Prior to re-entering the unit verify that conditions have not changed and that work permits are still valid before commencing work. 1C) Prior to leaving the unit notify operations of any issues or unusual observations made during the monitoring event. Complete appropriate facility documentation as required.	

1 each process unit will have specific chemical and physical hazards associated with the unit to be monitored. This step in the general jsa will document the steps to be used to gather the appropriate hazard information for the specific unit.

2 psm – process safety management information. Typically, the client will have a brief write-up of the unit process and potential hazards associated with unit operation.



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

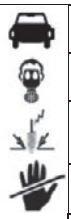
JSA Version Date: August 15, 2017		
Job Description: Drilling Oversight		
Project: True Companies	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Bryce Dorr	Engineer	307-745-7474
2. Brandon Ruckman	Engineer	307-745-7474
3.		

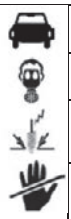
Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kathy Brown	Project Manager	8/15/2017
2.		/ /
3.		/ /

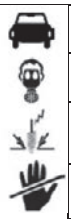
Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
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☒ Industrial Work Gloves	☒ Sunscreen	☐ Ammonia Cartridge
☒ Chemical Resistant Gloves	☒ Insect Repellant	☐ H2S Escape Cartridge
☒ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☒ Air Monitoring Equipment, PID	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)								Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Utility locates						X			A. Utility strike B. Biological hazards (spiders, stinging insects, etc.) C. Temperature stress	A. Request that driller contact One-Call (811) and locate underground utilities at least 48 hours prior to drilling. Visually locate overhead utilities and buried utilities and stay clear of these lines. Use a utility checklist to verify potential utilities have been located and marked. B. Survey area for hazards while walking site. Maintain the area around equipment/structures/wells clear of vegetation by a 2' radius to prevent harborage of biological hazards. Thoroughly inspect equipment for insects and signs of insect activity. Use an insecticide if insects are present (follow manufacturer's directions). Do not spray DEET on FRCs. Wear work gloves to protect against stings/bites. C. Dress in layers for cold weather or loose-fitting light clothing for hot weather, but within constraints of HASP. Drink plenty of water or other hydrating liquids (i.e., not sodas).	
2. Drill rig inspection							X	X	A. Inadequate inspection B. Hand lacerations C. Pinch points D. Head struck-against E. Slips/trips/falls	A. Review driller's inspection checklist. Note the locations and verify by testing that drill rig kill switches are in working order. Verify safety latches on winch hooks, check for worn cathead rope or frayed cable, check for presence of an adequate number of cable connectors on winch lines. B. Inspect rig for sharp edges and remove, if possible. Wear industrial work gloves. C. Keep hands clear of pinch points. Label pinch points. Wear industrial work gloves. D. Stay alert of equipment proximity. Wear hard hat during inspection. E. Remove debris and slip/trip hazards from work zone. Keep tools organized and out of pathway. Implement good housekeeping practices.	
3. Mobilize to sample		X							A. Vehicular traffic	A. Follow posted speed limits,	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
location					B. Overhead utility strikes C. Other site activities	traffic signs, and restrictions. Become familiarized with the site. Be aware of site activities. Watch for and be aware of vehicular traffic related to contractors. Develop a traffic control plan. Wear high visibility vest or clothing. B. Heavy equipment needs to remain a minimum 4' from energized overhead power lines (and other utilities) while in transport. If required to encroach within the restricted zone, power lines must be de-energized or insulated by the utility company/authorized electrician. C. Familiarize yourself with ongoing and current site activities. Visually check drilling locations prior to setting up. Make sure path to the intended location is stable for a drill rig and has adequate vertical and lateral clearance.	
4. Set up at sample location		X X 			A. Overhead utilities strike B. Backing rig: struck-by, property damage C. Personal injury: unauthorized entrants D. Moving rig	A. Begin by walking site location and identifying overhead lines. Heavy equipment must remain 10' minimum from energized overhead power lines when erected. If required to encroach within the restricted zone, power lines must be de-energized or insulated by the utility company/authorized electrician. B. If it is necessary to back up, use a spotter; verify spotter and driver use standard hand signals. Spotter to wear high visibility vest and stay in view of driver. Survey the area for obstacles prior to backing. C. Establish a work zone large enough to encompass the rig in the event it tips over. Unauthorized personnel and non-essential workers are to remain out of the work zone. D. Set up rig on even ground, if possible. Set parking brake and extend outriggers. Use outrigger cribbing for unstable or previously disturbed ground. Use wheel chocks on slopes.	

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
5. Observe drilling		A. High noise level B. Flying debris C. Struck-by D. Slip/trips/falls E. Equipment failure F. Severe weather	A. Hearing protection required within 25 feet of operating equipment or when employees cannot maintain a normal conversation at a 2-foot interval. B. Stay away from rotating augers. Verify that "skirt" is in place on air rotary rigs to prevent cuttings from becoming airborne. C. Personnel are not to stand under suspended loads. D. Keep work area clear of tools and equipment. E. Establish the work zone large enough to encompass the rig height in the event of tip-over and to prevent rig or rig components contacting personnel in the event of equipment failure. Prevent entry of non-essential or unauthorized personnel. F. Locate nearest severe weather shelter/strong structure before beginning field work. Suspend fieldwork if lightning occurs within 10 miles of site or severe weather warning issued.	
6. Sample collection		A. Injury from drill rig moving and powered parts B. Struck-by: dropping steel samplers C. Slips, trips, and falls D. Lacerations to hands E. Chemical hazards F. Pinch hazards	A. Identify emergency shut-offs and verify functionality of each prior to sampling activities. Review drilling/Geoprobe rig emergency procedures. Keep a safe distance from moving and powered parts. Only authorized and essential personnel are allowed in the work zone. B. Sample over a tailgate to prevent dropped parts from contacting feet. Wear safety-toed boots. C. Keep work area clean and clear of equipment, tools, spoils, etc. Keep area clear of ice, snow, gravel, etc. that could present a slip/trip hazard. D. Use Geoprobe acetate liner cutter to cut liner. Wear cut-resistant gloves. E. Wear nitrile gloves when handling soil samples. If visual staining is observed, do not directly smell sample to identify odor. Wear H_2S detector for soils high in sulfur. F. Wear leather work gloves when transporting and opening sample equipment.	

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
7. Breakdown at drilling location	 X  X	A. Overhead utilities and obstructions B. Slips/trips/falls C. Bystander safety	A. Observe overhead lines and obstructions when lowering mast and tightening winch lines. Use spotter as needed when lowering mast and leaving work area. B. Keep work area clear of tools and equipment. C. Keep bystanders at a safe distance. Remove work area barricades as last item before leaving the work area.	
8. Transfer of impacted drilling waste	 X  X	A. Overhead utilities and obstructions B. Slips/trips/falls C. Dropping heavy items	A. When using roll-off containers or dump body trucks, use a spotter to watch for overhead lines and obstructions when containers or dump beds are being lowered or lifted. Stage roll-off containers in an area that is free of overhead obstructions and personnel not working on the project. Use a spotter when utilizing backhoe or similar equipment to transport or dump drums into roll-off containers. Keeps a safe distance from the soil loading/transfer area. Check that the driller uses safe work practices when transferring soils to the roll-off box. B. Maintain the work areas in a neat and orderly manner. Clean up loose or spilled soils. C. Use mechanical lifting methods when handling drums and similar containers. Personnel are not to stand beneath suspended loads including heavy equipment buckets.	
9. Air rotary specific	 	A. Fluid/splashes from surging borehole B. High pressure air hoses	A. In addition to standard PPE, use additional eye protection such as face-shields and/or goggles. Stay back from the borehole as much as the tasks will allow.	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
						B. Check that whip-checks are in place on all high pressure air hose connection including the compressor/hose connection. Do not stand near hose connections while the compressor is being used. Observe (from a safe distance) nearby boreholes/wells for the potential ejection of water/solids while compressor is in use. Observe other subsurface structures that have the potential of being damaged for any changes in condition. Stop work in the event that the pressurized air impacts the above discussed items.	
10. Auger specific		X			A. Rotating equipment (augers, catheads, etc.) B. Pinch points (augers)	A. Check that augers are stopped before attempting to collect any cuttings. Keep a safe distance from rotating equipment. Do not wear loose clothing or jewelry near rotating equipment. B. Wear steel-toed boots and laceration-resistant gloves.	



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

JSA Version Date: July 29, 2015		
Job Description: Excavation Monitoring/Heavy Equipment		
Project: True Companies	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Michelle Harper	Geologist	(907) 903-2177
2.		
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kathy Brown		
1.		/ /
2.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
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Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
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☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
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☐ Chemical Resistant Gloves	☒ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☒ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
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☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☒ *Other:* First Aid Kit
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Prior to arriving at Site, Project Manager verifies that permits, forms and training have been completed. Review HASP.					A. Administrative function, no hazards anticipated. B. Action is to ensure health and safety/regulatory/security compliance.	A. Maintain training ID and keep required records at the office. B. Have required training: Supervisor Training (Supervisors) OSHA 40-Hour HAZWOPER First Aid/CPR.	
2. Walking around the site.		X		X X	A. Slips, trips and falls. B. Temperature stress. C. Biological hazards. D. Vehicle traffic. E. Heavy construction/equipment hazards F. Flying debris/objects.	A. Watch footing and where you are walking. Stay alert to holes, debris and tools. Be alert. Be aware of location of structures and operating equipment. Take extra caution in rainy or muddy conditions; keep boots dry or use rubber boots. B. Dress appropriately but within constraints of HASP. Drink plenty of water or other hydrating liquids (i.e., not sodas) during hot weather. C. Look before you reach or step - watch for small animals, rodents, snakes, insects and spiders. Try to avoid and do not antagonize. Use insect repellant and mosquito nets as appropriate. D. Watch for and be aware of vehicular traffic related to contractors. E. Do not drive in path of operating equipment. Make yourself visible. Yield to heavy construction equipment until eye contact is made with operator and you are given the signal to proceed. Stay out of immediate area near heavy equipment. If you need to approach a piece of equipment, do not enter from the blind spots; stay at a safe distance away until eye contact is made with the operator. F. Be aware of potential falling/flying objects. Use hard hat and safety glasses with side shields to keep airborne dust particles and flying debris out of eyes. Take caution when removing glasses so particles do not fall from glasses into eyes.	

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
3. Observe and document excavation activity.	 X  X X	A. Noise. B. Heat stress. C. Severe weather. D. Uneven walking surfaces E. Biological hazards. F. Slips, trips and falls. G. Struck by equipment.	A. Hearing protection is required within 25 feet of operating heavy construction equipment. Wear ear-plugs or muffs if noise is >85-dB. If you have to raise your voice to speak to a person that is at arm's length, noise is probably >85-dB. B. Take breaks. Drink fluids. Know personal limits (use buddy system). Know signs and symptoms of heat stress. Wear correct PPE. C. Locate nearest severe weather shelter/strong structure before beginning field work (covered in kick-off meeting). Suspend field work if lightening is within 10 miles of site or tornado warning issued. D. Watch your footing, stay away from excavation edge to prevent shear failure. E. Inspect area for hazardous plants and organism conditions. Avoid such areas if possible. Wear clothing that covers potentially affected body parts. Seal pant legs against contact with plants and to prevent access by organisms. Use insect/tick repellant whenever possible. F. Keep path clear. Survey walking path before entering into area. Be aware of ground tripping hazards. Be aware of slick, wet ground surfaces. Utilize caution when walking down slopes. G. Remain a safe distance away from heavy equipment. Communicate with operator before entering equipment work area and obtain permission.	
	 			



As the Supervisor my signature below indicates that the requirements, conditions, and procedures listed above are in place and have been verified and reviewed with the affected personnel prior to the start of work.

Supervisor Name (print):	**Signature**	**Date**

Prior to work, I have read and understand the PPE, safety tools/equipment/instruments, and associated permits needed for this task. I also understand the job steps, potential hazards, and critical actions identified for employee task and hazard awareness. I agree to have this JSA on site and identify daily variances and understand I can make pen and ink changes to meet those variances. JSAs used at the task site that contain pen-and-ink changes ("dirtying up") are to be kept in the project folder for record.

Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

JSA Version Date: February 21, 2011 (Updated 1/2014)		
Job Description: Excavation Observation		
Project: True Companies	Site Location:	

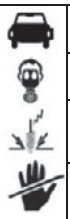
Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Louis Racchini		307-745-7474
2.		
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1.		
2.		
3.		

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☒ Hard Hat	☒ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☒ Ear Plugs	☐ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☒ Industrial Work Gloves	☐ Sunscreen	☐ Ammonia Cartridge
☐ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☒ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Pre-task coordination and safety meeting		A. Poor communication B. Personnel safety C. Weather hazards	A. Field staff review job-specific work plan and project manager to verify that up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, utility locates, and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Review CoP site requirements. (Companies performing the excavation are required to submit the one call utilities locate request.) B. A tailgate safety meeting must be performed and documented at the beginning of each workday. Work Site Self Assessment (WSSA) procedures mu be used throughout the project. C. Weather conditions (heat, cold, rain, and lightning) must also be considered.	
2. Mobe to location	X	A. Vehicle damage, collision, injuries	A. Observe site speed limits; be aware of site conditions or obstacles; park vehicle strategically out of the way of site traffic; no cell phone use while driving.	
3. Observe excavation	X	A. Poor communication B. Property loss and injury from excavating into or striking underground utility.	A. Verify that digging location is correct and that utilities locate are completed. B. Maintain visual “line-of-sight” with operator, communicate intentions, do no enter any excavated area, stay away from edge of excavation in case of cave ins. Observe ground surface, wear correct PPE, and maintain clear distance from excavated area.	
4. Observe/supervise the operator during trenching and backfilling		A. Cave-in, personal and property damage/loss, equipment failure	A. Maintain visual “line-of-sight” with operator; maintain safe distance from backfill area.	

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
5. Site communications		A. Information not being received/translated correctly to appropriate persons	A. Have contractor notify of any incidents or near misses. Notify project manager from Trihydro.	
6. Observe traffic control and excavated area protection	X 	A. Traffic hazard, personal and property damage/loss, traffic accidents	A. Observe traffic control to verify that barricades/cones/fence/etc. are in place, and that excavated area is barricaded off from public. Set Haul routes if appropriate.	
				
				



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

JSA Version Date: 04/12/2018		
Job Description: Fueling Vehicle		
Project: True Companies	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Kyle Haag	Project Manager	(701) 290-4272
2.		
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1.		
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☐ Hard Hat	☐ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☐ Ear Plugs	☐ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☒ Industrial Work Gloves	☐ Sunscreen	☐ Ammonia Cartridge
☐ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☐ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☐ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☒ *Other:* Fire extinguisher	☐ Personnel Decontamination	☐ *Other:*
☒ *Other:* First aid kit	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Unlock fuel pump and reset counter				X	Fuel spill	1) Inspect around fuel tank, hoses and pumps for any potential fuel leaks or damage to equipment.	
2. Place nozzle into vehicle fuel tank and begin to fill up the tank		X		X	Fire hazard, spills, exposure to vapors, and potential frostbite during the cold weather	1) Do not smoke. 2) Check that nozzle is secure in the gas tank before dispensing fuel. Be cognizant as to when the tank is full because the dispenser may not have an automatic shut-off. 3) Stand upwind to limit exposure to fuel vapors. 4) Wear gloves in the winter months so you do not get frostbite while handling the steel pump and nozzle.	
3. Inspecting in process unit.		X		X	High noise levels, heights, temperature (heat or cold from process or insulation), electric shock, and ergonomic hazards	1) Always wear appropriate hearing protection when working in operating process units. 2) Prior to proceeding to height or monitoring location, review equipment that will be used to reach destination. Follow the appropriate site procedures for the piece of equipment (e.g. ladders, scaffolding, man lifts) 3) Prior to proceeding monitor the surrounding area for physical hazards – close equipment, temperature, insulation, etc.	
4. Remove nozzle from tank and place it in its proper place. Turn off pump and lock it.		X		X	Fuel dripping from nozzle onto clothes or body, exposure to vapors, damage line while putting it back causing a release	1) Check that nozzle is off when removing it from the vehicle tank 2) Stand upwind 3) Check that fuel line and nozzle are within the concrete confinement area	



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

JSA Version Date: September 6, 2010		
Job Description: Gauging Fluid Levels		
Project: True Companies	Site Location: Oklahoma	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1.		
2.		
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1.		/ /
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☐ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☒ Hard Hat	☒ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☐ Ear Plugs	☐ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☐ Industrial Work Gloves	☐ Sunscreen	☐ Ammonia Cartridge
☒ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☐ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☒ Leather Boots	☐ Ventilation Fan	
☐ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☒ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
Open Well	X X X X	A. Struck-by traffic B. Slips/Trips/Falls C. Biological hazards (spiders, stinging insects, poisonous snakes, etc.) D. Pinch hazards E. Temperature stress	A. Park vehicle on an angle between well and same-lane of traffic as protection and about 10 – 20' from well, based on traffic speed. Set traffic cone ~50 behind vehicle to alert traffic. Wear a high visibility vest or jacket. B. Survey ground and walking path for trip and slip hazards. C. Survey area for snakes, insects, and other hazards while approaching well. Maintain the area around wells clear of vegetation by a 2' radius to prevent harborage of biological hazards. Thoroughly inspect well casing for insects and signs of insect activity. Use an insecticide if insects are present (follow manufacturer's directions). Wear work gloves to protect against stings/bites. Wear snake gaiters in areas with poisonous snakes. D. Avoid pinch points such as hinges, lids, or caps. Wear work gloves. E. Dress in layers for cold weather or loose-fitting light clothing for hot weather, but within constraints of HASP. Drink plenty of water or other hydrating liquids (i.e., not sodas).	
Gauge Well	 X X	A. Contact with contaminated water or NAPL B. Hand lacerations	A. Wear nitrile gloves and safety glasses. Avoid direct skin contact with fluids. Lower and remove fluid level gauge slowly to avoid splashing fluids. B. Keep hands clear of sharp edges of tape or wear work gloves.	
Decontaminate probe and tape	 X X	A. Contact with contaminated water or NAPL B. Hand lacerations	A. Wear nitrile gloves and safety glasses. Avoid direct skin contact with fluids. B. Keep hands clear of sharp edges of tape or wear work gloves.	
Close and lock well	 X	A. Pinch hazards	A. Avoid pinch points such as hinges, lids, or caps. Wear work gloves.	



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

JSA Version Date: May 1, 2014		
Job Description: GPS Surveying		
Project: True Companies	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Michelle Harper	Geologist	307-745-7474
2.		
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kathy Brown	Project Manager	5/21/2014
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☒ Hard Hat	☒ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
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Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☒ Industrial Work Gloves	☒ Sunscreen	☐ Ammonia Cartridge
☐ Chemical Resistant Gloves	☒ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☒ Air Monitoring Equipment (4-gas and H_2S monitors)	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
Prior to arriving at Site, project team will review HASP and sign.					Administrative function - no hazards anticipated. Action is to ensure health and safety compliance	Preventative Measures: Employees must have required training: Supervisor Training (Supervisors) OSHA 40-Hour HAZWOPER, Drug screening (as required), and H2S Awareness training.	
Conduct tailgate safety meeting each morning prior to beginning work.					Unaware of hazards causing personal injury or equipment/ property damage Weather hazards	Perform site orientation and safety assessment in meeting Observe weather and forecasts, postpone work if extreme weather conditions are expected.	
Site Access				X	Contact with obstructions Slip, Trip, Fall	Observe the area for obstructions or vehicles in the way. Notify site owners at least 24 hours prior to working and have owners move obstacles as necessary. Walk the path before driving and/or taking the vehicle off road.	
Set up at area of survey	X			X	Slip/trip/fall hazards. Vehicle damage, heavy equipment operations. Damage to equipment/property.	If surveying on foot, park vehicles out of traffic, properly don survey equipment and walk to location. Examine ground for potential hidden hazards such as open pits or debris. Keep eyes on path, proceed slowly and cautiously. Observe site speed limit of 15 mph. Be aware of construction equipment, yield to construction equipment. Avoid obstacles or hazards that could damage property	
Survey and document survey target	X			X	Slip/trip/fall hazards. Weather factors such as heat stress/fatigue, cold exposure/wind chill, rain, snow, lightning.	Walk and stand on solid ground, and stay clear of open holes, pits or other hazardous terrain. Move slowly and cautiously. Drink plenty of water and take breaks as needed, avoiding long periods of strenuous activity in the heat. Wear proper cold weather clothing and limit exposure due to wind chill. Stop work and seek shelter in the event of lightning or thunderstorm.	
Demobilization	X			X	Slip/trip/fall hazards. Vehicle damage. Construction/vehicle traffic	Be aware of potential obstructions or hazards in the road, or those hidden by vegetation. Observe safe vehicular speeds and traffic routes. Check that all equipment is secured down properly before movement.	



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

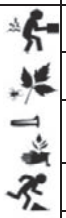
JSA Version Date: September 6, 2010		
Job Description: Groundwater Sampling		
Project: True Companies	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1.		
2.		
3.		

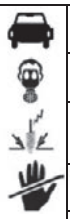
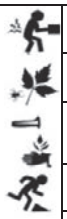
Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1.		/ /
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☐ Fire Retardant Coveralls	☐ Barriers/Guard Rails
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☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
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☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
Open well		X X X		 X X	A. Struck-by traffic B. Slips/Trips/Falls C. Biological hazards (spiders, stinging insects, poisonous snakes, scorpions, etc.) D. Chemical hazards (exposure to H_2S) E. Pinch hazards F. Temperature stress	A. When sampling near roads or city/county work areas, park vehicle on an angle between well and same-lane of traffic as protection and about 10 – 20' from well, based on traffic speed. Set traffic cone ~50 behind vehicle to alert traffic. Wear a high visibility vest or jacket. B. Survey ground and walking path for trip and slip hazards. C. Survey area for snakes, insects, and other hazards while approaching well. Maintain the area around wells clear of vegetation by a 2' radius to prevent harborage of biological hazards. Thoroughly inspect well casing for insects and signs of insect activity. Use an insecticide if insects are present (follow manufacturer's directions). Do not spray DEET on FRCs. Wear work gloves to protect against stings/bites. Wear snake gaiters in areas with poisonous snakes. D. Stand upwind when opening well. Wear an H_2S meter that has been tested for the day. Wear chemical PPE, including nitrile gloves and safety glasses. E. Avoid pinch points such as hinges, lids, or caps. Wear work gloves. F. Dress in layers for cold weather or loose-fitting light clothing for hot weather, but within constraints of HASP. Drink plenty of water or other hydrating liquids (i.e., not sodas).	
Gauge well		 X		 X 	A. Contact with contaminated water or NAPL B. Hand lacerations C. Cross contamination	A. Wear nitrile gloves and safety glasses. Avoid direct skin contact with fluids. Lower and remove fluid level gauge slowly to avoid splashing fluids. B. Keep hands clear of sharp edges of tape or wear work gloves. C. Decontaminate probe between locations.	

Job Steps	Hazard(s)		Potential Hazard(s)	Critical Action(s)	Responsible Person
Purge well if bailer sampling		X	A. Contact with contaminated water or NAPL B. Spills C. Hand lacerations	A. Purge well according to SAP. B. Contain water in a 5-gallon or appropriate sample container to avoid spills on ground and surrounding area. C. Wear gloves when bailing to protect hands from burns or scratches from bailing twine.	
Label bottles		X	A. Contact with contaminated water or NAPL B. Hand lacerations	A. Use laceration, safe gloves for bottle labeling, preparation, and handling. B. Be aware of preservatives in bottles that could result in acid/base exposure.	
Sample groundwater		X	A. Lacerations from broken VOA B. Chemical exposure C. Pinch points	A. Inspect VOAs after unpacking. They are not to be shipped from the lab with glass-to-glass contact. Inspect for scratches or cracks; discard if present. Close VOA by holding at the very bottom and top with 3 fingers each; do not over tighten. B. Mixing of water and sample bottle preservatives creates a chemical reaction producing hazardous vapors. Maintain body upwind from sample bottle and vapors so as not to inhale the vapors. Wear nitrile gloves, safety glasses, and use the appropriate flow-through device for bailer sampling. C. When conducting low-flow sampling, pinch points are present when connecting hosing to peristaltic pump. Take your time when installing the tubing and keep hands clear of pinch points. Connect tubing with peristaltic pump de-energized.	
Measure water quality parameters		X	A. Chemical exposure B. Equipment damage	A. Wear nitrile gloves. Avoid contact with calibration solutions. B. Avoid water that contacts equipment. Measure the groundwater in a container that is not likely to tip.	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
Package samples				X	A. Contact with contaminated water or NAPL B. Hand lacerations C. Cold exposure	A. Use laceration, safe gloves for bottle labeling, preparation, and handling. B. Be aware of preservatives in bottles that could result in acid/base exposure. C. Wear appropriate protective gloves when packaging samples with ice to avoid cold exposure.	
							



Prior to work, I have read and understand the PPE, safety tools/equipment/instruments, and associated permits needed for this task. I also understand the job steps, potential hazards, and critical actions identified for employee task and hazard awareness. I agree to have this JSA on site and identify daily variances and understand I can make pen and ink changes to meet those variances. JSAs used at the task site that contain pen-and-ink changes ("dirtying up") are to be kept in the project folder for record.

Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

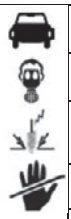
JSA Version Date: May 1, 2014		
Job Description: H2S Awareness		
Project:	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Michelle Harper	Geologist	307/745-7474
2.		
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kathy Brown	Project Manager	
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☒ Hard Hat	☒ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☐ Ear Plugs	☐ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☒ Industrial Work Gloves	☐ Sunscreen	☐ Ammonia Cartridge
☐ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☒ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
Bump Test/Calibrate					Malfunctioning meter Poor atmosphere	Check that the gas meter selected is appropriate for the job. Test/calibrate the meter according to manufacturer's specifications to ensure the meter if functioning properly. Prepare the meter in a clean atmosphere. (Before entering the site and outside of the working area.) If working outside perform actions outside and not inside a vehicle. Document bump test/calibrations on field forms.	
Affix meter to your breathing zone.		X			Meter not reading air that you are breathing causing over exposure	Affix the meter to your personal breathing zone, preferably on or near the collar of your shirt. DO NOT place the meter in an area away from your nose and mouth e.g. back pocket, back of hard hat, front pants pocket, etc.	
Avoid depressions and other potentially dangerous locations		X			Over exposure	If possible avoid depression that could contain H2S. DO NOT enter any confined space or location that could present a hazard.	
Evacuate area		X			Health risks	Should the meter signal a warning, immediately evacuate the area proceeding in an up/cross wind direction to the muster point and contact your supervisor.	



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

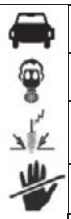
JSA Version Date: 04/12/2018		
Job Description: Maintenance of TVA 2020 Instrument		
Project:	Site Location:	

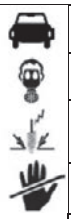
Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Various LDAR Team Members		
2. Kyle Haag	Project Manager	(701) 290-4272
3.		

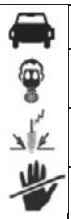
Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kyle Haag	Project Manager	04/12/2018
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☐ Hard Hat	☐ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☐ Ear Plugs	☒ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☐ Industrial Work Gloves	☐ Sunscreen	☐ Ammonia Cartridge
☐ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☐ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Battery Charging	 X 	A. Overcharging, Fire Hazard/Explosion B. Equipment Damage	A. Do not use the battery charger in any area classified as hazardous due to the presence of flammable gases or vapors. Do not leave the battery on charge for extended periods due to the potential to overheat. B. Use the charger provided with the unit. Follow manufacturer's instructions for charging unit. Note: the battery is typically nickel cadmium and should the battery no longer hold a charge – follow proper disposal or recycle instructions as in instruction manual.	
2. Changing of Battery	 X 	A. Fire Hazard B. Compressed Gas Hazard	A. Do not use the battery charger in any area with the presence of flammable gases or vapors. B. Use caution when placing the battery back into the TVA. It should only go in one way and the wires should be placed in carefully so as not to crimp or pinch.	
3. Filling of the Hydrogen Gas Tank	 	A. Fire Hazard B. Compressed Gas Hazard	A. Perform task in well-ventilated area where flammable vapors/gases are not present. B. Verify that gauges and regulators are in proper working order and are appropriate for use with the cylinders, and hydrogen. Check that connections have been properly made/not been damaged and that they are tight prior to opening valves. CAUTION – Do not over-tighten. Upon opening of the valves – LISTEN for any escaping hydrogen. If any is heard, stop the operation, and prepare to find the leak using a soapy water solution. Monitor the pressure of the instrument cylinder. (For the TVA 1000 the cylinder is rated at 2200 psig). DO NOT OVERFILL cylinder.	

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
4. Servicing the PID or FID cartridge	 X	A. Electric Shock B. Exposure	A. Prior to performing any maintenance on the detector cartridge associated with the instrument, check that the instrument has been turned off and is disconnected from the charger. B. Check that the hydrogen supply valve is in the off position. Utilize the proper tools and follow the manufacturer's instructions.	
5. Servicing the FID Cartridge		A. Fire Hazard	A. The procedure for cleaning utilizes a small quantity of isopropyl alcohol. This is a flammable material and should be used in a well-ventilated area and away from ignition sources. B. Care should also be taken to check that the igniter coil is not contacted as this can create a potential fire hazard.	
6. Cleaning the FID Detector Cap		A. Fire Hazard B. Compressed Air	A. The procedure for cleaning utilizes a small quantity of isopropyl alcohol. This is a flammable material and should be used in a well-ventilated area and away from ignition sources. B. The procedure calls for "blowing out carefully" with compressed dry air. It is essential that the air pressure is monitored so as not to create skin penetration or additional hazards such as dust or projectiles.	
7. Replacing the Flame Arrestor Filter Element		A. Electrical Shock B. Fire C. Equipment Damage	A. Prior to performing any maintenance, check that the instrument has been turned off and is disconnected from the charger. B. Check that the hydrogen supply valve is in the off position. Utilize the proper tools and follow the manufacturer's instructions. C. Use caution when replacing the filter element so as not to cause damage to the flame arrestor.	

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
8. Replacing Water Trap Probe Filter and O-rings	 X 	A. Electrical Shock B. Fire C. Equipment Damage	A. Prior to performing maintenance, check that the instrument has been turned off and is disconnected from the charger. B. Check that the hydrogen supply valve is in the off position. C. Utilize the proper tools and follow the manufacturer's instructions.	
9. Cleaning or Replacing the Metal Dust Filter	 X 	A. Electrical Shock B. Fire C. Equipment Damage	A. Prior to performing maintenance, check that the instrument has been turned off and is disconnected from the charger. B. Check that the hydrogen supply valve is in the off position. C. Utilize the proper tools and follow the manufacturer's instructions.	
10. Replacing the Sample Line	 X 	A. Electrical Shock B. Fire C. Equipment Damage	A. Prior to performing maintenance, check that the instrument has been turned off and is disconnected from the charger. B. Check that the hydrogen supply valve is in the off position. C. Utilize the proper tools and follow the manufacturer's instructions.	



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

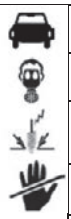
JSA Version Date:		
Job Description: LDAR Monitoring		
Project: True Companies	Site Location:	

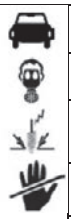
Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Various LDAR Team Members		
2. Kyle Haag	Project Manager	(701) 290-4272
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kyle Haag	Project Manager	04/12/2017
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☒ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☒ Hard Hat	☐ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☒ Ear Plugs	☒ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☒ Industrial Work Gloves (as needed)	☐ Sunscreen	☐ Ammonia Cartridge
☐ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☒ Air Monitoring Equipment (H2S Detector)	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Transportation to and from job site.	 X 	A. Vehicle malfunctions, vehicle accidents, striking objects, pedestrian or other vehicle traffic, road hazards, etc. B. Personal injury C. Traffic accident D. Unit hazards E. Backing accident F. Following client requirements	A. Prior to starting the vehicle verify that the vehicle is in good working order, mirrors have been properly adjusted, and the surroundings have been observed for potential hazards. Note: Drivers have completed a defensive driving course and vehicle inspection forms have been completed. B. Wear seatbelt C. Follow traffic regulations (both outside and inside the facility.) D. Follow procedures associated with vehicles in units as required by Trihydro and the facility. E. Avoid backing, however if backing is required – back upon parking and use a spotter when possible. F. Follow facility parking regulations (location, keys in ignition, shut of engine while parked, etc.)	
2. Unit entry – prior to monitoring	 X 	A. Communication Hazard B. Operations Hazard C. Chemical Hazards	A. Be familiar with the unit or area to be monitored and review the PSM information provided by the facility. Note: be aware of the appropriate evacuation routes for the unit and facility. B. Discuss physical hazards with operator (high noise, walking surfaces, maintenance work in the area, low hanging equipment, etc.) C. Discuss chemical hazards with operator. LDAR monitoring is looking for VOC leaks, thus, it is anticipated that hydrocarbon materials with be encountered. Additionally, there are common non-hydrocarbon chemicals that can be encountered such as H2S. Identify the need for additional PPE if applicable.	
3. Unit Entry	 X 	A. Entry hazards B. Chemical hazards C. Permitting hazards	A. Follow the facility unit entry procedures. Discuss changes that have occurred within the unit that monitoring personnel should be aware of prior to entering the unit. B. Ensure that the proper PPE for the unit and task is being used. C. Obtain appropriate work permits required for the unit/facility.	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
4. Inspecting in process unit				X	A. High noise levels B. Chemical hazards C. Site specific hazards D. Slips/Trips/Falls	A. Wear appropriate hearing protection when working in operating process units. B. Wear proper PPE and personal monitors. Complete bump tests on personal monitor as required/needed. Understand the facility/unit specific procedures should a personal monitor alarm. At a minimum evacuate the area and report to unit operator. C. Understand facility/unit alarms for evacuations and/or releases. D. Pay particular attention to the general vicinity around the monitoring area. Report to operator of potential slip, trip, or fall hazards.	
5. Inspecting in process unit at heights				X	A. Falling hazard – Ladder B. Aerial equipment C. Scaffolding	A. Follow procedure for working on or around elevated work surfaces. When climbing ladders use three points of connection. When using portable ladders, follow the facility procedures for inspecting, documenting and securing ladders and use appropriate ladder angles (refer to ladder procedures as needed.) B. Only trained individuals are able to operate any aerial equipment. If trained ensure training meets facility requirements. Follow the safety procedures as outlined in the Trihydro and facility safety procedures. C. If scaffolding is used, check that the safety policies and procedures are being followed. Check that the appropriate inspections and tags are in place prior to using the scaffold.	
6. Leaving the Unit – Breaks, Lunch, or at the End of Monitoring Shift					A. Unit Exit B. Unit Entry	A. Prior to leaving the unit notify operations of any issues or unusual observations made during the monitoring event. Complete appropriate facility documentation as required B. Prior to re-entering the unit, verify that conditions have not changed and that work permits are still valid before commencing work.	



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

JSA Version Date: 01/2021		
Job Description: Optical Gas Imaging Survey – Oil & Gas Environment		
Project: GHG Monitoring	Site Location: All Applicable Facilities	
Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Kurt Benson	Staff Scientist	(307) 760-6583
2. Dan Wood	Staff Scientist	(307) 761-3410
3. Nick Carlson	Staff Scientist	
Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Jeremy Sell	Business Unit Leader	1/01/2021
2.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☒ Hard Hat	☒ Reflective Safety Vest (Only needed in high traffic areas)	☒ Half-Face Air Purifying Respirator (Only needed when work is required in hazardous atmospheres. Use all possible administrative controls before conducting work in a hazardous atmosphere.)
Hearing Protection	☒ Camera Shoulder Harness	☐ Full-Face Air Purifying Respirator
☒ Ear Plugs (only needed in high noise areas)	☒ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☒ Industrial Work Gloves	☐ Sunscreen	☐ Ammonia Cartridge
☐ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☒ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
Transportation at job site.	X	A. Vehicle and pedestrian hazards B. Driving hazards C. Poor road conditions D. Driving hazards E. Vehicle and pedestrian hazards F. Driving hazards	A. Prior to starting the vehicle verify that the vehicle is in good working order, mirrors have been properly adjusted, and the surroundings have been observed for potential hazards. Note: All drivers must have completed a defensive driving course and vehicle inspection forms should be completed. B. Wear seatbelt. C. Obey traffic regulations. Use 4 Wheel Drive when necessary. Verify safe travel conditions on roads before leaving. D. Avoid backing, however if backing is required – back upon parking and use a spotter when possible. E. Follow facility parking regulations (location, keys in the ignition, shut off engine when parked, etc.). F. Follow any site specific procedures or regulations associated with vehicles as required by Trihydro and the facility.	
Daily Instrument Checks	X X	A. Instrument malfunction B. Equipment malfunction C. Slips, trips, and falls D. Venting pressurized gas E. Explosion/chemical hazards F. Inadequate storage of compressed gas (i.e. explosion risk)	A. Inspect instrument prior to use. B. Inspect gas cylinder and associated equipment prior to use. C. Camera operator should not walk while using the camera so he/she is aware of his/her surroundings and path obstacles. D. Secure location of calibration gas release. Verify area is clear of open flames and other potential hazards. E. Gas is flammable, care should be taken to turn valve of the flow regulator to the off position prior to removal of the regulator. F. Store cylinder and regulator in a safe, cool area.	
Facility Check-in	X	A. Personal injury: general site hazards, unauthorized entry B. Hazardous atmospheres	A. Check in with operations and site contact prior to plant entry to discuss other work that is taking place and may impact the survey (e.g., chemical releases, high-traffic zones, etc.). B. The camera is NOT intrinsically safe. Obtain the pertinent	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
						permits (e.g., hot work or safe work) and ensure operators are aware of the potential risks associated with exposure of the camera to a flammable atmosphere and that air monitoring is performed prior to area entry.	
Optical Gas Imaging Survey		X X 		X X X	A. General site hazards B. Temperature stress, Biological hazards C. Slips, trips, and falls, Biological hazards (spiders, stinging insects, poisonous snakes, scorpions, etc.) D. Vehicle and pedestrian hazards E. Flying/falling debris and other objects (eye protection) F. Hearing loss G. Chemical exposure H. Fire, LEL, H_2S, Hazardous atmospheres I. Slips, trips, and falls J. Personnel Safety K. Ergonomic hazards	A. Maintain good housekeeping practices to eliminate slip/trip/fall hazards. Watch footing and where you are walking. Stay alert to holes, debris, and tools. Be aware of location of structures and operating equipment. Take extra caution in rainy or muddy conditions and when standing on oily surfaces. B. Dress in layers for cold weather or loose-fitting light clothing for hot weather, but within constraints of HASP. Drink plenty of water or other hydrating liquids. C. Look before you reach or step; watch for small animals, rodents, snakes, insects, and spiders. Use insect repellant and mosquito nets as appropriate. Do not spray DEET on FRCs. D. Watch for and be aware of vehicular traffic. Wear high-visibility vest when needed. E. Be aware of potential flying/falling objects. Wear hard hat and safety-toed boots. Wear safety glasses with side shields to keep flying debris out of eyes. Wear dust-proof safety glasses if airborne dust is a hazard. Take caution when removing glasses so particles do not fall from glasses into eyes. F. Use hearing protection when entering area with noise level of 85 Decibels or greater. G. The purpose of the survey is to identify leaks of greenhouse gases that may be occurring from equipment and piping. Camera operator should stand upwind and/or maintain a suitable distance from leaks observed so as not to expose oneself to the emitted gas. H. Carry a 4-gas meter to identify concentrations of toxic gases and LEL.	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
						I. Camera operator should not walk while using the camera so as to be aware of his/her surroundings and path obstacles. J. Camera should be secure at all times. K. A full day's use of the OGI camera can put stress on the elbows, shoulders, neck and upper back. If available, alternate operators often, use camera shoulder harness, or take frequent breaks if alone.	



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

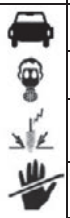
JSA Version Date: 09/6/2010		
Job Description: Packing Samples for Shipment		
Project: True Companies	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1.		
2.		
3.		
Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Todd Forry	RPIH, CECM, Industrial Hygienist	09/06/2010
2.		
3.		

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☐ Hard Hat	☐ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☐ Ear Plugs	☐ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☐ Industrial Work Gloves	☐ Sunscreen	☐ Ammonia Cartridge
☒ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☒ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☐ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
Transferring field samples to sample packing area.	X X	A. Personal injury from improper lifting. B. Broken glass. C. Chemical exposure.	A. Use proper lifting techniques. Do not twist while lifting. B. Wear appropriate gloves (laceration protection) when handling sample containers, keep area clear of unnecessary materials. C. Wear appropriate gloves when handling sample containers.	
Remove bottles and packaging from coolers and sort by sample location or bottle type	X X	A. Chemical/Lacerations: Exposure to impacted water on bottles. & cuts from broken VOAs and bottles. B. Packing Hazards: Broken or dropped glass bottles resulting in injury to personnel, spilled preservatives, lost sample	A1. When opening cooler visually check for broken bottles or bottles with fluid on the outside Ab. Wear nitrile gloves with Cut resistant gloves under them B1. Avoid glass-on-glass contact when handling sample bottles B2. Wipe off exterior of bottles that have liquid on them B3. Handle one sample bottle at a time	
Place shipping liner into coolers and replace packaging		A. Temperature/Chemical: Leaking cooler (melted ice) will be rejected by shipper resulting in loss of samples and data B. Damaged shipping container C. Loss of samples	A. Verify that liner is intact before placing it in cooler B. Inspect cooler for cracks (interior and exterior) C. Do not use cracked coolers for sample shipment	
Fill ice bags for placement in coolers (below and on top of sample bottles)	X	A. Slip and fall hazard from ice spilled on floor resulting in injury to personnel or dropped and lost sample B. Temperature: Inadequate ice used for keeping samples at lab required temperature	A. Clean up spilled ice immediately to remove slip hazard. Use paper towels to absorb melted water from spilled ice B. Place samples on ice immediately during hot months and once in the lab area. During summer months place one bag of ice on the bottom of the samples and a second bag of ice on top of the samples.	
Place sample bottles in cooler, use bubble wrap on glass bottles, All coolers require a temperature blank, VOC samples require a trip blank		A. Damaged samples- Unprotected glass bottles can break in transit resulting in injury to lab personnel from glass and/or spilled impacted water B. Chemical/Temperature: Lack of temperature and trip blank can result in inadequate lab data or lab rejection of samples	A. Avoid glass-on-glass contact when handling sample bottles Verify that lab supplied bubble wrap packing is used on large glass bottles Place VOC vials in foam sample packs for protection B. Visually verify that each sample cooler has the appropriate temperature blank prior to sealing the cooler	

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
			Use temperature blanks from sample refrigerator, verify that they are not frozen Ship all VOC sample vials for the sample day/event in the same sample cooler with the accompanying COC and Trip Blanks	
Verify COC Form is complete and taped to inside lid of cooler, tape coolers closed with custody seal under tape		A. Lack of COC or custody seal can result in rejection of samples by lab resulting in wells requiring re-sampling B. Cutting packing tape used to seal coolers could result in injury to personnel	A. Verify sample locations, times, and dates on sample bottles matches the information on the COC form Verify that all collected sample bottles collected are accounted for on the COC form. Clave COC in zip lock back so it does not get damaged is vials break. Verify that each sample cooler being shipped has a signed custody seal that has been placed across the lid opening B. Use safety knives (self-retracting blade) or scissors to cut tape Wear Cut resistant gloves underneath nitrile gloves when packing samples for shipment	
				



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

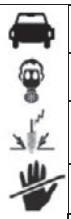
JSA Version Date: 04/12/2018		
Job Description: Calibration of the TVA 2020		
Project:	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Various LDAR Team Members		
2. Kyle Haag	Project Manager	(701) 290-4272
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kyle Haag	Project Manager	04/1/2018
2.		
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☐ Hard Hat	☐ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
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☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☐ Industrial Work Gloves	☐ Sunscreen	☐ Ammonia Cartridge
☐ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☐ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Starting and warming of the instrument.	 X	A. Equipment failure B. Electrical shock/fire	A. Check that the TVA 1000 is in working order. Examine the instrument to check that hydrogen tank and batteries have been properly installed. Follow the manufacturer's instructions for proper warm up of the instrument. Note: The pump must be on during the warm up time. Check that the date and time are correct before calibrating the instrument. B. Examine all cables to check that they are not frayed or electrical lines exposed. Check that the sample probe has been connected properly.	
2. Collection of calibration gases (if bags are used).		A. Equipment failure B. Exposure C. Fire	A. Verify that the appropriate compressed gas cylinders are being used. (Typically, calibration gases for this service are concentrations of methane in air.) B. Only fill bags in a well-ventilated area. Check that the regulators are appropriately installed and that the cylinders are properly secured. Check connections to the bags. Use the appropriate bag for the gas to be filled. If the bag is damaged replace prior to use. Check configuration for filling. C. Each site will have a site specific configuration and verify that the appropriate valves are opened in the appropriate sequence. DO NOT overfill bag.	
3. Calibrating Instrument		A. Fire Hazard B. Equipment Damage	A. For the purposes of calibration, you will be introducing a flammable gas to the unit. Caution must be used to ensure that there are no ignition sources that could result in a fire. Perform calibration in a well-ventilated area. Check that when calibrating that you are using the correct span gas per facility. B. If using tedlar bags, do not press down on bag, this will cause damage to the pumping system.	



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Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

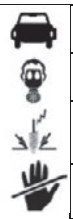
JSA Version Date: 04/12/2018		
Job Description: Filling of the Hydrogen Tank for the TVA 2020		
Project:	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Various LDAR Team Members		
2. Kyle Haag	Project Manager	(701) 290-4272
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kyle Haag	Project Manager	04/12/2018
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☐ Hard Hat	☐ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator (if necessary)
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☐ Ear Plugs	☒ Long sleeved shirt	☐ Chemical Cartridge
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☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☐ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
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Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Maintaining and Storing the Supplemental Hydrogen Supply		A. Cylinder damage. B. Equipment damage/fire	A. The hydrogen cylinder should be an approved stamped DOT cylinder supplied by the compressed gas supplier. The cylinder should be secured in a cylinder rack and should be stored away from cylinders containing oxygen or other highly oxidizing or combustible materials. NOTE: Theis storage consideration should also apply to “empty” cylinders. B. Use the appropriate regulator for hydrogen cylinders, and the appropriate tools. Store cylinders in a well-ventilated area.	
2. Connecting the Hydrogen Tank for Refilling		A. Compressed Gas and Fire Hazard	A. Start with the supply tank valve off and then attach the fill adapter to supply tank with valve off, and with manifold valve off. A safe refill operation means that there are no hydrogen leaks. Before any valves are opened, ensure that connections to the hydrogen supply tank and the tank fill adapter are tight. Hydrogen fittings are left hand thread. DO NOT over-tighten. LISTEN – If escaping hydrogen is heard, close all valves and correct the leak before processing. Leak test with soapy water.	
3. Filling the Tank	 X	A. Compressed Gas and Fire Hazard B. Exposure	A. Before any valves are opened, check that connections to the hydrogen supply tank and the tank fill adapter are tight. Hydrogen fittings are left hand thread. DO NOT over-tighten. LISTEN – If escaping hydrogen is heard, close all valves and correct the leaks before proceeding. Leak test with soapy water or equivalent. Follow the manufacturers	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
						recommended procedure. B. Do not stand in front of the cylinder while refilling. Stand off to the side to watch the gauge. Once finished refilling the cylinder, close the supply valve, check that the fill valve is in the off position, and remove the cylinder. Turn on the fill valve to bleed out excess hydrogen, and then return it to the off position.	



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Name (print):	**Signature**	**Date**

END OF DAY

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(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

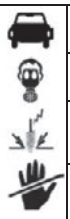
JSA Version Date: August 15, 2017		
Job Description: Vehicle Operations		
Project: True Companies	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Michelle Harper	Geologist	307-745-7474
2.		
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
Todd Forry	Health & Safety	8/2/2024
		/ /

Personal Protective Equipment (PPE). Check and obtain all that are needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☐ Safety Glasses	☐ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☐ Hard Hat	☐ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
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☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☒ *Other:* Vehicle Emergency Kit
☐ *Other:*	☒ *Other:* First Aid Kit	☒ *Other:* Fire Extinguisher

Job Steps	Hazard(s)		Potential Hazard(s)	Critical Action(s)	Responsible Person
1. Plan Travel Route			A. Getting lost, vehicle crash, construction, traffic	A. Complete Journey Management Form. Observe weather; be mindful of traffic patterns; watch for construction. Drivers will have completed a defensive driving course.	
2. Vehicle Inspection	 X		A. Vehicle crash, fire, damage, injury	A. Inspect vehicle for tire condition, light operations, fuel status, fire extinguisher, first aid kit and document on inspection form. Complete Trihydro's vehicle inspection form prior to departure. Perform walkaround, i.e. GOAL check prior to driving away from parking spot.	
3. Vehicle Operation	 X	 X	A. Vehicle damage, injury B. Traffic C. Backing D. Unfamiliar vehicle E. Speeding F. Skids G. Blind spots H. Distractions I. Impaired driving J. Off-road hazards K. Biological	A. Wear seat belt, adjust mirrors. B. Plan route. C. Perform vehicle walk-around, use spotter if available, use pull through parking. D. Take time to familiarize with controls. E. Observe posted speed limits. F. Adjust driving to road conditions. G. Stay out of vehicle blind spots. H. Refrain from talking on cell phone, eating, reading maps while driving. I. Never drive under the influence of alcohol or drugs. J. Refrain from off-road travel unless using an appropriate vehicle and have reconned driving path. Walk path prior to driving off road. Avoid driving in tall dry grass where a hot catalytic convertor or muffler could ignite a fire. K. Look before you reach or step - watch for small animals, rodents, snakes, insects and spiders. Wear snake gaiters if in areas where the ground surface is not clearly visible. Avoid and do not antagonize animals. Use insect repellant and mosquito nets as appropriate	



Prior to work, I have read and understand the PPE, safety tools/equipment/instruments, and associated permits needed for this task. I also understand the job steps, potential hazards, and critical actions identified for employee task and hazard awareness. I agree to have this JSA on site and identify daily variances and understand I can make pen and ink changes to meet those variances. JSAs used at the task site that contain pen-and-ink changes ("dirtying up") are to be kept in the project folder for record.

Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

JSA Version Date: 12/14/2022		
Job Description: Well Plugging and Abandonment		
Project: BFPC Elmore Ranch	Site Location: Gillette, Wyoming	
Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Andrew Vann	Environmental Engineer	(307) 745-7474
2.		
3.		
Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Pak Landers	Field Technician	4/21/2015
2. Josh Shaver	Environmental Technician	12/14/2022
3.		

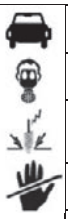
Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☐ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
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Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☒ Ear Plugs	☐ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☒ Industrial Work Gloves	☒ Sunscreen	☐ Ammonia Cartridge
☐ Chemical Resistant Gloves	☒ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☐ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☐ Equipment Decontamination	
☒ *Other:* Safety Knife or scissors	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
Load equipment	X X X	A. Lifting hazards B. Slips/trips/falls C. Trailer problems D. Loss of items in transport	A. Use proper lifting technique (keep feet shoulder width apart, keep the load close to your body, and lift with legs) and two people for heavy items B. Check that walking surface is free of obstructions, use ramp to load trailer C. Verify trailer is in good working condition, connect trailer to truck correctly using proper equipment, do not overload trailer D. Secure items in trailer and truck bed using tie-downs as appropriate	
Driving with trailer	X	A. Traffic/trailer hazards	A. Use 3-D driving procedures, be aware of increased acceleration and stopping distances, make wide turns, merge lanes carefully, be aware of trailer's effect on truck on wet or snowy roads	
Load water	X X	A. Slips/trips/falls B. Overload trailer	A. Be aware of wet or icy surfaces, make sure of stable position prior to turning on the water B. Confirm trailer capacity	
Onsite setup	X X	A. Traffic hazards B. Slips/trips/falls	A. Set up cones to divert traffic from work area, wear orange vest and maintain traffic awareness B. Be aware of surface conditions such as snow, ice, and water, keep tools and equipment off the ground or out of walkways	
Cut well using inside pipe cutter on drill (powered by generator).	X X X	A. Pinch hazards B. Rotating blade/drill C. Electrical hazards D. Noise E. Bending hazards	A. Check that saw blade is straight and not damaged before each well. Wear leather gloves. B. Keep hands and loose clothing or jewelry back away from rotating shaft of the drill and blade of the saw. C. Keep cords dry and make sure a GFCI is used on the generator D. Wear ear plugs when working in close proximity to generator E. Use proper lifting techniques (keep feet shoulder width apart, keep the load close to your body, and lift with legs) when lifting heavy items.	

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
Plug well with bentonite or sand-mix concrete	X (Dust inhalation); X (Lifting/bending hazards); X (Lacerations)	A. Lacerations B. Dust inhalation C. Lifting/bending hazards	A. Use proper tools such as safety knife/scissors to open bags B. Pour bentonite or sand-mix concrete slowly to avoid dust generation, stand upwind. Wear an air purifying respirator when dumping bentonite or sand-mix down well if excessive dust is generated. C. Use proper lifting techniques (keep feet shoulder width apart, keep the load close to your body, and lift with legs) when lifting heavy items.	
Cut pavement surrounding wellheads	X (Flying debris); X (Dust inhalation); X (Rotating saw blade); X (Bending hazards); X (Noise)	A. Flying debris B. Dust inhalation C. Rotating saw blade D. Bending hazards E. Noise F. Utility contact (directly under pavement) G. Traffic hazards	A. Wear safety glasses with side shields and leather gloves. B. Wear an air purifying respirator when operating or working in close proximity to gas saw. C. Keep feet, hands, and loose clothing away from rotating blade of gas saw. Do not set saw down or work on blade until it has stopped rotating. Wear leather gloves. D. Use proper lifting techniques (keep feet shoulder width apart, keep the load close to your body, and lift with legs) when lifting heavy items. E. Wear ear plugs when operating or working in close proximity to gas saw. F. Be aware of the possibility of cutting electrical lines or cables and pipes, if you come in contact with a utility service stop work and call emergency contact immediately. G. Set up cones to divert traffic from work area, wear orange vest and maintain traffic awareness	

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
Jackhammer pavement/wellhead apron	X X X X	A. Flying debris B. Jackhammer hazards C. Noise hazards D. Posture E. Traffic hazards	A. Wear safety glasses with side shields and leather gloves. B. Never attempt to handle the bit or load the jackhammer while it is still plugged in. Place bit on pavement to be broken before attempting to operate jackhammer. C. Wear ear plugs when operating or working in close proximity to jackhammer or generator. D. Keep back as straight as possible when operating jackhammer. Keep feet shoulder width apart and away from the bit of the jackhammer, wear steel toed boots with an impact rating of at least 75 lbs. E. Set up cones to divert traffic from work area, wear orange vest and maintain traffic awareness	
Load debris into truck	X X X	A. Sharp metal from well boxes B. Lifting hazards C. Traffic hazards	A. Wear leather gloves when handling debris. B. Use proper lifting techniques (keep feet shoulder width apart, keep the load close to your body, and lift with legs) when lifting heavy items. Use your legs for major lifting with shovel. C. Set up cones to divert traffic from work area, wear orange vest and maintain traffic awareness	
Fill hole with flow fill or dirt to bottom of pavement (or surrounding dirt surface)	X X	A. Lifting hazards (if using dirt) B. Compactor hazards (if using dirt) C. Noise hazards D. Traffic hazards	A. Keep your feet shoulder width apart and your back straight when lifting or using the compactor. B. Keep feet out from under the foot of the compactor and wear steel toed boots with an impact rating of at least 75 lbs. C. Wear ear plugs when working in close proximity to compactor. D. Set up cones to divert traffic from work area, wear orange vest and maintain traffic awareness	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
Install concrete using sack mix		X X X		X 	A. Eye hazards from concrete splashing B. Lifting hazards C. Dust inhalation D. Lacerations E. Traffic hazards	A. Wear safety glasses with side shields. B. Use proper lifting techniques (keep feet shoulder width apart, keep the load close to your body, and lift with legs) when lifting heavy items. C. Wear an air purifying respirator when dumping bags of concrete and mixing if excessive dust is generated. D. Use proper tools such as safety knife/scissors to open bags, use bucket opener to remove bucket lids E. Set up cones to divert traffic from work area, wear orange vest and maintain traffic awareness.	



Prior to work, I have read and understand the PPE, safety tools/equipment/instruments, and associated permits needed for this task. I also understand the job steps, potential hazards, and critical actions identified for employee task and hazard awareness. I agree to have this JSA on site and identify daily variances and understand I can make pen and ink changes to meet those variances. JSAs used at the task site that contain pen-and-ink changes ("dirtying up") are to be kept in the project folder for record.

Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

JSA Version Date: April 25, 2014		
Job Description: Well Gauging		
Project:	Site Location:	

Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Louis Racchini	Senior Hydrogeologist	(307) 745-7474
2.		
3.		

Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kathy Brown	Project Manager	5/21/2014
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	*Body Protection*	*Fall Protection*
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	*Respiratory Protection*
☒ Hard Hat	☒ Reflective Safety Vest	☐ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☐ Ear Plugs	☐ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	*Biological Protection*	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☒ Industrial Work Gloves	☒ Sunscreen	☐ Ammonia Cartridge
☒ Chemical Resistant Gloves	☒ Insect Repellant	☐ H2S Escape Cartridge
☐ Laceration Resistant Gloves	*Hazardous Atmosphere Protection*	☐ Asbestos Filter (P-100)
Foot Protection	☒ Air Monitoring Equipment (4-gas and H_2S monitors)	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	*Decontamination Materials*	
☐ Waders	☒ Equipment Decontamination	
☐ *Other:*	☐ Personnel Decontamination	☐ *Other:*
☐ *Other:*	☐ *Other:*	☐ *Other:*

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
Investigation of work area		X			A. Slips, trips, falls. B. Biological hazards. C. Cuts. D. Traffic.	A. Investigate the work area before beginning work. Pay particular attention to inclined surfaces, slick areas, and other terrain concerns. B. Inspect area for spiders or evidence of spiders or other biological hazards such as wasps and snakes. C. Pay attention to any sharp objects in the work area, and carefully move them from the work zone if possible. D. Inspect the surroundings for the possibility of traffic hazards. Set up barricades as needed. Wear a reflective vest.	
				X			
		X		X			
Open well					A. Biological hazards. B. Hand injury, pinch points. C. Tool hazards.	A. Inspect well casing for spiders or evidence of spiders or other insects such as wasps. B. Observe casing for sharp edges or other damage, wear proper gloves, keep hands clear of pinch points such as hinges, lids or caps. C. Use the proper tools to remove wells covers.	
				X			
		X					
Gauge well					A. Contact with contaminated water. LNAPL, or vapor exposure. B. Eye injury from liquids.	A. Wear chemical resistant gloves. Lower/raise gauge slowly to prevent splashing. Stand upwind of well. B. Wear safety glasses with side shields.	
		X					
				X			
Decon probe and tape					A. Dermal contact with contaminated water or NAPL. B. Eye injury from liquids.	A. Wear chemical resistant gloves. Lower/raise gauge slowly to prevent splashing. B. Wear safety glasses with side shields. If deconning in buckets, wash slowly to prevent splashing. If using spray bottles, be aware of the direction you're spraying.	
				X			
Close and lock well					A. Pinch points from well lids or covers.	A. Keep hands clear of pinch points.	
		X					



Prior to work, I have read and understand the PPE, safety tools/equipment/instruments, and associated permits needed for this task. I also understand the job steps, potential hazards, and critical actions identified for employee task and hazard awareness. I agree to have this JSA on site and identify daily variances and understand I can make pen and ink changes to meet those variances. JSAs used at the task site that contain pen-and-ink changes ("dirtying up") are to be kept in the project folder for record.

Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

JOB SAFETY ANALYSIS

Trihydro

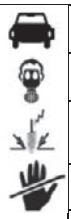
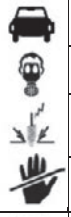
JSA Version Date: May 1, 2014		
Job Description: Drilling/Well Installation		
Project:	Site Location:	

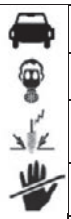
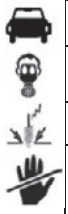
Development Team Please include the team members employer and email if not employed by Trihydro Corporation:	**Position/Title:**	**Primary Contact**
1. Michelle Harper	Geologist	307/745-7474
2.		
3.		

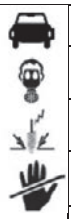
Reviewed By Please include the reviewers employer and email if not employed by Trihydro Corporation:	**Position**	**Review Date (MM/DD/YYYY)**
1. Kathy White	Project Manager	
2.		/ /
3.		/ /

Personal Protective Equipment (PPE) Needed:

Eye and Face Protection	***Body Protection***	***Fall Protection***
☒ Safety Glasses	☒ Fire Retardant Coveralls	☐ Barriers/Guard Rails
☐ Face Shield	☐ Poly-coated Tyvek Coveralls	☐ Safety Net
☐ Chemical Goggles	☐ Chemical Resistant Coveralls	☐ Personal Fall Arrest System
Head Protection	☐ Chemical Resistant Apron	***Respiratory Protection***
☒ Hard Hat	☒ Reflective Safety Vest	☒ Half-Face Air Purifying Respirator
Hearing Protection	☐ Cooling Vest	☐ Full-Face Air Purifying Respirator
☒ Ear Plugs	☐ Long sleeved shirt	☐ Chemical Cartridge
☐ Ear Muffs	***Biological Protection***	☐ Particulate Filter
Hand Protection	☐ Snake Gaiters	☐ Cartridge/Filter Combo
☒ Industrial Work Gloves	☐ Sunscreen	☐ Ammonia Cartridge
☒ Chemical Resistant Gloves	☐ Insect Repellant	☐ H2S Escape Cartridge
☒ Laceration Resistant Gloves	***Hazardous Atmosphere Protection***	☐ Asbestos Filter (P-100)
Foot Protection	☒ Air Monitoring Equipment	☐ Powered Air Purifying Respirator (PAPR) **(contact H&S dept.)**
☐ Leather Boots	☐ Ventilation Fan	
☒ Steel-Toed Boots	☐ Level C	☐ Supplied Air Respirator (SAR) **(contact H&S dept.)**
☐ Chemical Resistant Boots	☐ Level B **(contact H&S dept.)**	
Water Safety	☐ Level A **(contact H&S dept.)**	☐ Self-Contained Breathing Apparatus (SCBA) **(contact H&S dept.)**
☐ Personal Flotation Device	***Decontamination Materials***	
☐ Waders	☒ Equipment Decontamination	
☐ ***Other:***	☐ Personnel Decontamination	☐ ***Other:***
☐ ***Other:***	☐ ***Other:***	☐ ***Other:***

Job Steps	Hazard(s)	Potential Hazard(s)	Critical Action(s)	Responsible Person
Utility locates completed previously	 X	Electrocution, explosions, expensive repairs, fines	Coordinate with drilling contractor to contact One-Call (800-849-2476) or 811 at least 2 full working days prior to digging (off site applicable). Private utililites should be located by on-site contacts or a private utlity locate company. Mark the area to be excavated/drilled with water soluble markings on unpaved areas. Before using power equipment, expose the location by hand to a point of no conflict 24" on either side of the utility. Trihydro workers will complete Trihydro's Utility Clearance and Drilling/Excavation best practice class.	
Conduct tailgate safety meeting and excavation checklist each morning prior to beginning work.		If contractors are not made aware of site safety hazards, an incident could occur	Check that the drilling contractors are in compliance with all site safety policies. Discuss new topics or highlight a topic for each day's meeting. Ask the subcontractors for their input.	
Mobilize to drilling location.	 X	Vehicular and human site traffic, refinery operations	Drive within the site speed limits and familiarize workers with the site and current site activities. Do not leave vehicles running while unoccupied and leave keys in the vehicle with the doors unlocked	
Set up at drilling location	 X X	Overhead and underground utilities. Injuries to bystanders or fixed equipment by backing into them.	Begin by walking the location. Check that utilities have been clearly marked and sample locations have been cleared. If unsure the location is clear or not, do not proceed. Contact the site manager for confirmation. Set up a safe distance (20 feet or more) from overhead lines. Check that bystanders and vehicles are at a safe distance from the drill rig activities. Attempt to drive forward into a location. If it is necessary to back up, use a spotter. Check the ground is stable so the rig will not get stuck.	
Chock wheels.	 X	Rig could move while no one is at controls.	Chock wheels. Check that the vehicle is in park and the brake is on.	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
Drillers show onsite personnel where the emergency shut off is for the rig and where it is safe to observe operations.					All moving and powered parts.	Review emergency procedures and show location of emergency shut off and verify proper operation.	
Drilling.		X X		X X	Dropping steel samplers on feet/toes. Slip, trip or fall hazards. Equipment breakage. Chemical exposure from the drill rig and borehole (e.g. when disconnecting drill stem rods). Drillers clothing getting tangled in the augers. Back injuries from lifting heavy augers. Long hair in rotating parts. Being struck from overhead cables/hooks.	Wear proper PPE which may additionally include a face shield to protect from splash hazards. Maintain a clear work area free of tools and equipment, keep walking paths open. Complete rig inspection checklist and document. Wear appropriate PPE. Do not wear overly loose fitting clothing. Use proper lifting techniques, do not twist while lifting. Request help when necessary. While shoveling do not overload the shovel or turn the torso very far. Long hair to be tied back securely and braid tucked into clothing. Communicate with co-workers when shoveling or maneuvering a swing-hook from the drill mast.	
Breakdown at drilling location.		X			Rig damage.	Do not drive unless the mast is lowered. Check that augers and tools are secured to the rig before moving.	
Core barrel recovery and core extraction.		X		X	Carrying heavy load; finger/hand pinches in core vice.	Wear Nitrile gloves. Additionally wear leather work gloves when moving the core barrel itself; always have 2 people carry and lock-down the core for opening.	
Well casing assembly and installation.		X			Pinch-points at threads. Swinging long pipe sections near personnel.	Use work gloves. Pay attention to task; inform workers at the well site of upcoming activities.	

Job Steps	Hazard(s)				Potential Hazard(s)	Critical Action(s)	Responsible Person
Installing well box surface completion.				X	Sharp metal edges on well box could cut fingers. Muscle strains from mixing concrete, pushing wheelbarrow, lifting shovel with concrete mixture or dumping wheelbarrow.	Wear work gloves. Share tasks with coworkers. Take your time, communicate.	
		X					



Prior to work, I have read and understand the PPE, safety tools/equipment/instruments, and associated permits needed for this task. I also understand the job steps, potential hazards, and critical actions identified for employee task and hazard awareness. I agree to have this JSA on site and identify daily variances and understand I can make pen and ink changes to meet those variances. JSAs used at the task site that contain pen-and-ink changes ("dirtying up") are to be kept in the project folder for record.

Name (print):	**Signature**	**Date**

END OF DAY

REVISIONS TO JSA
(Any tasks that were "dirtied up")

Date	Job Step #	REVISION	Does JSA need to be updated permanently?		Responsible Person
			Yes	No	

APPENDIX D

SAFETY DATA SHEETS (SDSs)

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

1 Identification of the substance/mixture and of the supplier

1.1 GHS Product identifier

Trade Name: Alconox®

Product number: 1101, 1103, 1104, 1104-1, 1112, 1112-1, 1125, 1150

1.2 Application of the substance / the mixture: Cleaning material/Detergent

1.2.1 Recommended dilution ratio: 1 – 2% in water

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer:
Alconox Inc.
30 Glenn St
White Plains, NY 10603
(914) 948-4040

Supplier:

Emergency telephone number:
ChemTel Inc
North America: 1-888-255-3924
International: +1 813-248-0573

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272, 29CFR1910/1200 and GHS requirements.

Hazard-determining components of labeling:
Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Eye damage, category 1.

Skin irritation, category 2.

Product at recommended dilution:
Eye irritation, category 2B

Hazard pictograms:



Signal word: Danger

Hazard statements:
H315 Causes skin irritation.
H318 Causes serious eye damage.

Precautionary statements:
P264 Wash skin thoroughly after handling.

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Hazardous Elements at Use Dilution:

Hazard Pictograms:



Signal Word: Warning
Hazard Statements:
H320 Causes eye irritation

Precautionary statements:
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P501 Dispose of contents and container as instructed in Section 13

Additional information: None.

Hazard description
Hazards Not Otherwise Classified (HNOC): May cause surfaces to become slippery if wet. Use caution in areas of foot traffic if on floors.

Information concerning particular hazards for humans and environment:
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:
The classification is according to EC regulation No. 1272, 29CFR1910/1200 and GHS Requirements, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization: Not determined or not available.

3.2 Description: None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Skin Irrit. 2; H315 Eye Irrit. 2; H319	12-28
CAS number: 68081-81-2 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2; H315 Eye Dam. 1; H318	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2; H315 Eye Irrit. 2; H319	2-16

Hazardous components at use dilution (percentages by weight):

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Eye Irrit. 2; H319	0.12 - 0.28
CAS number: 68081-81-2 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Eye Irrit. 2; H319	0.08 – 0.22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Eye Irrit. 2; H319	0.02 – 0.16

3.4 Additional Information: None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:

Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:

Wash affected area with soap and water.
Seek medical attention if symptoms develop or persist.

After eye contact:

Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.
Seek medical attention if irritation persists or if concerned.

After swallowing:

Rinse mouth thoroughly.
Seek medical attention if irritation, discomfort, or vomiting persists.

4.2 Most important symptoms and effects, both acute and delayed

None

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information.

First aid measure at recommended dilution:

General information: None.

After inhalation:

Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:

Wash affected area with soap and water.

After eye contact:

Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.

After swallowing:

Rinse mouth thoroughly. Seek medical attention if irritation, discomfort, or vomiting develops.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents: None

5.2 Special hazards arising from the substance or mixture:

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:

Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information:

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions:

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up:

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections: None

7 Handling and storage

7.1 Precautions for safe handling:

No expected hazards under normal use condition.

Avoid breathing mist or vapor if aerosolized.
Do not eat, drink, smoke or use personal products when handling chemical substances.

7.2 Conditions for safe storage, including any incompatibilities:

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

8 Exposure controls/personal protection





8.1 Control parameters:

a) 7722-88-5, Tetrasodium Pyrophosphate, ACGIH TWA 10 mg/m3
b) 7758-29-4, Sodium Tripolyphosphate, ACGIH TWA 10 mg/m3
c) Dusts, non-specific OEL, Irish Code of Practice
   (i) Total inhalable 10 mg/m3 (8hr)
   (ii) Respirable 4 mg/m3 (8hr)
   (iii) Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3, (8hr)

8.2 Exposure controls

Appropriate engineering controls:
Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:
Not needed under normal use conditions.

Protection of skin:
Select glove material impermeable and resistant to the substance.

Eye protection:
Safety goggles or glasses, or appropriate eye protection. Recommended to comply with ANSI Z87.1 and/or EN 166.

General hygienic measures:
Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.

Exposure Control and Personal Protective Equipment at recommended dilution:

Under normal use and operational conditions, no special personal protective equipment or engineering controls will be necessary. Handle with care.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower:** **Explosion limit upper:**	Not determined or notavailable. Not determined or notavailable.
Odor:	Not determined or not available.	**Vapor pressure at 20°C:**	Not determined or notavailable.
Odor threshold:	Not determined or not available.	**Vapor density:**	Not determined or notavailable.
pH-value:	9.5 (1% aqueous solution)	**Relative density:**	Not determined or notavailable.

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Melting/Freezing point:	Not determined or not available.	**Solubilities**:	Not determined or notavailable.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water)**:	Not determined or notavailable.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature**:	Not determined or notavailable.
Evaporation rate:	Not determined or not available.	**Decomposition temperature**:	Not determined or notavailable.

Flammability (solid, gaseous):	Not determined or not available.	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 Reactivity: Not determined or not available.
10.2 Chemical stability: Not determined or not available.
10.3 Possibility hazardous reactions: Not determined or not available.
10.4 Conditions to avoid: Not determined or not available.
10.5 Incompatible materials: Not determined or not available.
10.6 Hazardous decomposition products: Not determined or not available.

11 Toxicological information

11.1 Information on toxicological effects:

Acute Toxicity:

Oral:

: LD50 > 5000 mg/kg oral rat - Product.

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Sodium Alkylbenzene Sulfonate: Causes skin irritation.

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye damage.

Tetrasodium Pyrophosphate: Risk of serious damage to eyes.

Product information at recommended dilution:

Eye irritation may occur upon direct contact with eyes. No specific hazards for skin contact, inhalation, or chronic exposure are expected within normal use parameters.

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.9 mg/l, 48 hours.
Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Tetrasodium Pyrophosphate: Fish, LC50 - other fish - 1,380 mg/l - 96 h.
Tetrasodium Pyrophosphate: Aquatic invertebrates, EC50 - Daphnia magna (Water flea) - 391 mg/l - 48 h.

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: ADR, ADN, DOT, IMDG, IATA		None
14.2 UN Proper shipping name: ADR, ADN, DOT, IMDG, IATA		None
14.3 Transport hazard classes: ADR, ADN, DOT, IMDG, IATA	**Class:** **Label:** **LTD. QTY:**	None None None

US DOT
Limited Quantity Exception: None

Bulk:	**Non Bulk:**
RQ (if applicable): None	**RQ (if applicable):** None
Proper shipping Name: None	**Proper shipping Name:** None
Hazard Class: None	**Hazard Class:** None
Packing Group: None	**Packing Group:** None
Marine Pollutant (if applicable): No additional information.	**Marine Pollutant (if applicable):** No additional information.

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Comments: None	**Comments:** None
14.4 Packing group: ADR, ADN, DOT, IMDG, IATA	None
14.5 Environmental hazards:	None
14.6 Special precautions for user:	None
Danger code (Kemler):	None
EMS number:	None
Segregation groups:	None
14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.	
14.8 Transport/Additional information:	
Transport category:	None
Tunnel restriction code:	None
UN "Model Regulation":	None

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act) Reportable

Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed as active.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

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Germany MAK: Not classified.
EC 648/2004 – This is an industrial detergent. Contains >30% phosphate, 15-30% anionic surfactant, <5% EDTA salts
EC 551/2009 – This is not a laundry or dishwasher detergent
EC 907/2006 – Contains no enzymes, optical brighteners, perfumes, allergenic fragrances, or preservative agents

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:
H315 Causes skin irritation.
H318 Causes serious eye damage.

NFPA: 1-0-0
HMIS: 1-0-0

At recommended dilution:
NFPA: 1-0-0
HMIS: 1-0-0

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

SAFETY DATA SHEET

Asbestos, Amosite

Section 1. Identification

GHS product identifier : Asbestos, Amosite

Product code : 02703A-AB; 02703-AB

Chemical name : Asbestos, grunerite

Other means of identification : Amosite Asbestos

Product type : Solid.

Relevant identified uses of the substance or mixture and uses advised against

Product use : Laboratory chemicals.

Area of application : Industrial applications, Professional applications.

Supplier's details : SPI Supplies Division Structure Probe, Inc.
206 Garfield Ave. West Chester, PA 19380
United States

Telephone: 1-(610)-436-5400
http://www.2spi.com

e-mail address of person responsible for this SDS : SDS@2spi.com

Emergency telephone number (with hours of operation) : **CHEMTREC**

Toll Free: 1-(800)-424-9300 (USA + Canada) (24/7)
International: 1-(703)-741-5970 (24/7)

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture :

H350	CARCINOGENICITY - Category 1A
H372	SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 1

GHS label elements

Hazard pictograms :



Signal word : Danger

Hazard statements : H350 - May cause cancer.
H372 - Causes damage to organs through prolonged or repeated exposure.

Precautionary statements

Section 2. Hazards identification

Prevention : P201 - Obtain special instructions before use.
P280 - Wear protective gloves. Wear protective clothing. Wear eye or face protection.
P260 - Do not breathe dust.
P270 - Do not eat, drink or smoke when using this product.

Response : P308 + P313 - IF exposed or concerned: Get medical advice or attention.

Storage : Not applicable.

Disposal : P501 - Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : Asbestos, grunerite

Other means of identification : Amosite Asbestos

CAS number/other identifiers

CAS number : 12172-73-5

Ingredient name	Other names	%	CAS number
Asbestos, grunerite	-	>99.99	12172-73-5

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health and hence require reporting in this section.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Section 4. First aid measures

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : In case of fire, use water spray (fog), foam or dry chemical.

Unsuitable extinguishing media : Do not use water jet.

Specific hazards arising from the chemical : No specific fire or explosion hazard.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
metal oxide/oxides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Move containers from spill area. Avoid dust generation. Do not dry sweep. Vacuum dust with equipment fitted with a HEPA filter and place in a closed, labeled waste container. Dispose of via a licensed waste disposal contractor.

Large spill : Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Avoid dust generation. Do not dry sweep. Vacuum dust with equipment fitted with a HEPA filter and place in a closed, labeled waste container. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not ingest. If during normal use the material presents a respiratory hazard, use only with adequate ventilation or wear appropriate respirator. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Empty containers retain product residue and can be hazardous. Do not reuse container.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Asbestos, grunerite	**ACGIH TLV (United States, 3/2019).** TWA: 0.1 f/cc 8 hours. Form: Respirable fibers: length greater than 5 uM; aspect ratio equal to or greater than 3:1 as determined by the membrane filter method at 400-450X magnification (4-mm objective) phase contrast illumination. **OSHA PEL (United States, 5/2018).** TWA: 0.1 f/cc 8 hours.

Appropriate engineering controls : If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.
Recommended: Rubber gloves.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Section 8. Exposure controls/personal protection

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Recommended: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator w/ full or ½ face N95 cartridge masks if exposure limits are exceeded or symptoms are experienced.

Section 9. Physical and chemical properties

Appearance

Physical state : Solid. [Fibrous solid.]

Color : Brown./ Gray./ Green.

Odor : Odorless.

Odor threshold : Not available.

pH : Not available.

Melting point : Not available.

Boiling point : Not available.

Flash point : Not available.

Evaporation rate : Not available.

Flammability (solid, gas) : Not available.

Lower and upper explosive (flammable) limits : Not available.

Vapor pressure : Not available.

Vapor density : Not available.

Relative density : 3.45

Density : 3.45 g/cm³

Solubility : Insoluble in the following materials: cold water and hot water.

Partition coefficient: n-octanol/water : Not available.

Auto-ignition temperature : Not available.

Decomposition temperature : >950°C (>1742°F)

SADT : Not available.

Viscosity : Not available.

Flow time (ISO 2431) : Not available.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.
Under normal conditions of storage and use, hazardous polymerization will not occur.

Conditions to avoid : Avoid dust generation.

Section 10. Stability and reactivity

Incompatible materials : Reactive or incompatible with the following materials: oxidizing materials, acids and alkalis.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Conclusion/Summary : Nuisance dust may affect the lungs but reactions are typically reversible.

Irritation/Corrosion

Not available.

Conclusion/Summary

Skin : Exposure to dust may cause mechanical irritation.

Eyes : Exposure to dust may cause mechanical irritation. Excessive concentrations of nuisance dust in the workplace may reduce visibility and may cause unpleasant deposits in eyes.

Sensitization

Not available.

Mutagenicity

Conclusion/Summary : Not available.

Carcinogenicity

Conclusion/Summary : Not available.

Classification

Product/ingredient name	OSHA	IARC	NTP
Asbestos, grunerite	+	1	Known to be a human carcinogen.

Reproductive toxicity

Conclusion/Summary : Not available.

Teratogenicity

Conclusion/Summary : Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
Asbestos, grunerite	Category 1	-	-

Aspiration hazard

Not available.

Information on the likely routes of exposure : Routes of entry anticipated: Oral, Dermal, Inhalation.

Section 11. Toxicological information

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

Conclusion/Summary : Chronic Effects May Include: Cancer, pulmonary fibrosis, pulmonary chronic lung disease.

General : Causes damage to organs through prolonged or repeated exposure.

Carcinogenicity : May cause cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

N/A

Section 12. Ecological information

Toxicity

Conclusion/Summary : Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Not available.

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

	DOT Classification	IMDG	IATA
UN number	NA2212	UN2212	UN2212
UN proper shipping name	Asbestos	ASBESTOS, AMPHIBOLE (Asbestos, grunerite)	Asbestos amphibole
Transport hazard class(es)	9 	9 	9 
Packing group	III	II	II
Environmental hazards	No.	No.	No.

Additional information

United States

Section 14. Transport information

DOT Classification : **Limited quantity** Yes.
Packaging instruction Exceptions: 155. Non-bulk: 216. Bulk: 216, 240.
Quantity limitation Passenger aircraft/rail: 200 kg. Cargo aircraft: 200 kg.
Special provisions 156, IB8, IP2, IP4

IMDG : **Emergency schedules** F-A, S-A
Special provisions 168, 274

IATA : **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Packaging instructions: Forbidden. Cargo Aircraft Only: Forbidden. Packaging instructions: Forbidden. Limited Quantities - Passenger Aircraft: Forbidden. Packaging instructions: Forbidden.
Special provisions A2, A61

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to IMO instruments : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 5(a)2 final significant new use rules**: Asbestos, grunerite
TSCA 6 final risk management: Asbestos, grunerite
TSCA 8(a) CDR Exempt/Partial exemption: Not determined
TSCA 12(b) one-time export: Asbestos, grunerite
United States inventory (TSCA 8b): All components are active or exempted.
Clean Water Act (CWA) 307: Asbestos, grunerite

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : CARCINOGENICITY - Category 1A
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 1

Composition/information on ingredients

Section 15. Regulatory information

Name	%	Classification
Asbestos, grunerite	>99.99	CARCINOGENICITY - Category 1A SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 1

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	Asbestos, grunerite	12172-73-5	>99.99
Supplier notification	Asbestos, grunerite	12172-73-5	>99.99

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : The following components are listed: AMOSITE ASBESTOS; GRUNERITE ASBESTOS

New York : The following components are listed: Asbestos

New Jersey : The following components are listed: ASBESTOS, AMOSITE; ASBESTOS, GRUNERITE

Pennsylvania : The following components are listed: ASBESTOS, GRUNERITE

California Prop. 65

⚠ **WARNING**: This product can expose you to Asbestos, which is known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov.

Ingredient name	No significant risk level	Maximum acceptable dosage level
Asbestos	Yes.	-

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Ingredient name	List name	Status
Amosite asbestos; Brown asbestos	Industrial	Listed

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Health	*	3
Flammability		0
Physical hazards		0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



Procedure used to derive the classification

Classification	Justification
CARCINOGENICITY - Category 1A	Calculation method
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 1	Calculation method

History

Date of issue/Date of revision : 07/02/2020

Date of previous issue : No previous validation

Version : 1

Prepared by : Sphera Solutions

Key to abbreviations : ATE = Acute Toxicity Estimate
AMP = Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
N/A = Not available
UN = United Nations

References : HCS (U.S.A.)- Hazard Communication Standard
International transport regulations

Indicates information that has changed from previously issued version.

Notice to reader

Section 16. Other information

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

ThermoFisher SCIENTIFIC

SAFETY DATA SHEET

Creation Date 22-Sep-2009 **Revision Date** 24-Dec-2021 **Revision Number** 5

1. Identification

Product Name **Bentonite**

Cat No. : **B235-500**

CAS No 1302-78-9
Synonyms tixoton; Southern bentonite; Bentonite magma

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company
Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
Classification under 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Label Elements

Hazard Statements

Precautionary Statements
Hazards not otherwise classified (HNOC)
None identified

3. Composition/Information on Ingredients

Component	CAS No	Weight %
Bentonite	1302-78-9	>95

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Get medical attention.

Inhalation Remove to fresh air. Get medical attention. If not breathing, give artificial respiration.

Ingestion Do NOT induce vomiting. Get medical attention.

Most important symptoms and effects . No information available

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.

Unsuitable Extinguishing Media No information available

Flash Point Not applicable
Method - No information available

Autoignition Temperature No information available

Explosion Limits
Upper No data available
Lower No data available

Oxidizing Properties Not oxidising

Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
None known.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
0	1	1	N/A

6. Accidental release measures

Personal Precautions Ensure adequate ventilation. Use personal protective equipment as required. Avoid dust formation. Avoid contact with skin, eyes or clothing.

Environmental Precautions Should not be released into the environment. See Section 12 for additional Ecological Information.

Methods for Containment and Clean Up Sweep up and shovel into suitable containers for disposal. Avoid dust formation. Provide adequate ventilation.

7. Handling and storage

Handling Wear personal protective equipment/face protection. Ensure adequate ventilation. Avoid contact with skin, eyes or clothing. Avoid ingestion and inhalation. Avoid dust formation. Handle under inert gas, protect from moisture.

Storage. Keep container tightly closed in a dry and well-ventilated place. Store under an inert atmosphere. Incompatible Materials. Strong oxidizing agents. Strong acids.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Bentonite	TWA: 1 mg/m^3			TWA: 1 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists

Engineering Measures None under normal use conditions.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection No protective equipment is needed under normal use conditions.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	Beige
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	No data available
Boiling Point/Range	No information available
Flash Point	Not applicable
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	No information available
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	Not applicable

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Hygroscopic. Moisture sensitive.

Conditions to Avoid Incompatible products. Excess heat. Avoid dust formation. Exposure to moist air or water.

Incompatible Materials Strong oxidizing agents, Strong acids

Hazardous Decomposition Products None under normal use conditions

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Bentonite	LD50 > 5000 mg/kg (Rat)	Not listed	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes, respiratory system and skin

Sensitization No information available

Carcinogenicity Possible cancer hazard. May cause cancer based on animal data. The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS No	IARC	NTP	ACGIH	OSHA	Mexico
Bentonite	1302-78-9	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Do not flush into surface water or sanitary sewer system.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea

Bentonite	Not listed	LC50: = 19000 mg/L, 96h static (Oncorhynchus mykiss)	Not listed	Not listed

Persistence and Degradability Insoluble in water

Bioaccumulation/ Accumulation No information available.

Mobility Is not likely mobile in the environment due its low water solubility.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT Not regulated
TDG Not regulated
IATA Not regulated
IMDG/IMO Not regulated

15. Regulatory information

United States of America Inventory

Component	CAS No	TSCA	TSCA Inventory notification - Active-Inactive	TSCA - EPA Regulatory Flags
Bentonite	1302-78-9	X	ACTIVE	-

Legend:
TSCA US EPA (TSCA) - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Japan (ISHL), Australia (AICS), China (IECSC), Korea (KECL).

Component	CAS No	DSL	NDSL	EINECS	PICCS	ENCS	ISHL	AICS	IECSC	KECL
Bentonite	1302-78-9	X	-	215-108-5	X	-		X	X	KE-02119

KECL - NIER number or KE number (http://ncis.nier.go.kr/en/main.do)

U.S. Federal Regulations

SARA 313 Not applicable

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act) Not applicable

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA Not applicable

California Proposition 65 This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations Not applicable

U.S. Department of Transportation
Reportable Quantity (RQ): N
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Authorisation/Restrictions according to EU REACH

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

Component	CAS No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
Bentonite	1302-78-9	Listed	Not applicable	Not applicable	Not applicable

Component	CAS No	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Major Accident Notification	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Rotterdam Convention (PIC)	Basel Convention (Hazardous Waste)
Bentonite	1302-78-9	Not applicable	Not applicable	Not applicable	Not applicable

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 22-Sep-2009
Revision Date 24-Dec-2021
Print Date 24-Dec-2021
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET





Revision Date 14-Jun-2017 **SDS Number** 888100008800 **Revision Number** 1.01

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY

Product Name **Crude Oil**

Synonyms Sour Crude Oil, Sweet Crude Oil, Light Crude Oil, Heavy Crude Oil, Generic Crude Oil

Recommended Use Refining feedstock
Uses advised against All others

Manufacturer
Tesoro Refining & Marketing Co.
19100 Ridgewood Parkway
San Antonio, TX 78259

Emergency Telephone Chemtrec: 1-800-424-9300
Tesoro Call Center: 1-877-783-7676

E-mail address ProductStewardship@TSOCORP.com

2. HAZARDS IDENTIFICATION

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Acute dermal toxicity	Category 4
Skin Corrosion/Irritation Category	Category 2
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1A
Reproductive toxicity	Category 2
Specific target organ toxicity (repeated exposure)	Category 1
Acute Aquatic Toxicity	Category 1
Chronic Aquatic Toxicity	Category 1

Label elements

Danger

Highly flammable liquid and vapor
Harmful in contact with skin
Causes skin irritation
May cause genetic defects
May cause cancer
Suspected of damaging fertility or the unborn child
Causes damage to organs through prolonged or repeated exposure
Very toxic to aquatic life with long lasting effects



Appearance Liquid

Physical State @20°C Liquid

Odor Petroleum asphalt odor. Hydrogen sulfide (H2S) has a characteristic rotten egg odor with an odor threshold as low as 10 parts per billion or even less. However, this odor should not be used as a warning property because H2S can deaden the sense of smell. H2S concentrations can be measured with an H2S meter or colorimetric indicating tubes.

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Wear protective gloves/protective clothing/eye protection/face protection
Wash face, hands and any exposed skin thoroughly after handling
Do not breathe dust/fume/gas/mist/vapors/spray
Do not eat, drink or smoke when using this product
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/or bond container and receiving equipment
Use explosion-proof electrical/ ventilating / lighting / equipment
Use only non-sparking tools
Take precautionary measures against static discharge

Precautionary Statements - Response
IF exposed or concerned: Get medical advice/attention
Call a POISON CENTER or doctor if you feel unwell
If skin irritation occurs: Get medical advice/attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower
Wash contaminated clothing before reuse
In case of fire: Use CO2, dry chemical, or foam to extinguish

Precautionary Statements - Storage
Store in a well-ventilated place. Keep cool

Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)
Not applicable

Other Information
May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No	Percent
Petroleum; Crude oil	8002-05-9	0-100
Sulfur	7704-34-9	0-5
Benzene	71-43-2	0.1-3
N-hexane	110-54-3	0-1.5
Xylene	1330-20-7	0-<1

Toluene	108-88-3	0-<1
Polycyclic Aromatic Hydrocarbons	130498-29-2	0-<1
Naphthalene	91-20-3	0-<1
Ethylbenzene	100-41-4	0-<1
Cumene	98-82-8	0-<1
Hydrogen Sulfide	7783-06-4	0-0.5

4. FIRST AID MEASURES

Description of first aid measures

General advice Show this safety data sheet to the doctor in attendance. Remove from exposure, lie down. In case of accident or if you feel unwell, seek medical advice immediately. When symptoms persist or in all cases of doubt, seek medical advice. Never give anything by mouth to an unconscious person. Take off all contaminated clothing immediately and thoroughly wash material from skin.

Inhalation Remove to fresh air. Get medical attention immediately if symptoms occur.

Eye contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Keep eye wide open while rinsing. Do not rub affected area. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation develops and persists.

Skin contact Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. If symptoms persist, call a physician.

Ingestion Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person. Call a physician.

Self-protection of the first aider Remove all sources of ignition. Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Use personal protective equipment as required. See section 8 for more information. Wear personal protective clothing (see section 8). Avoid contact with skin, eyes or clothing.

Most important symptoms and effects, both acute and delayed

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media Dry chemical. Carbon dioxide (CO2). Water spray. Alcohol resistant foam.

Small Fire Any extinguisher suitable for Class B fires, dry chemical, CO2, foam (AFFF/ATC), or water spray can be used.

Large Fire Water spray, fog or alcohol-resistant foam. CAUTION: Use of water spray when fighting fire may be inefficient. Cool containers with flooding quantities of water until well after fire is out.

Unsuitable extinguishing media CAUTION: Use of water spray when fighting fire may be inefficient.

Specific hazards arising from the chemical Risk of ignition. Keep product and empty container away from heat and sources of ignition. In the event of fire, cool tanks with water spray. Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.

Hazardous combustion products Smoke, CO, and other products of incomplete combustion.

Explosion data

Sensitivity to Mechanical Impact None.

Sensitivity to Static Discharge	Yes.
Special protective equipment for fire-fighters	Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible withdraw from area and let fire burn.
Further information	ALWAYS stay away from tanks engulfed in fire. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. Do not direct water at source of leak or safety devices; icing may occur. Cool containers with flooding quantities of water until well after fire is out. Do not allow run-off from fire-fighting to enter drains or water courses.

NFPA **Health hazards** 2 **Flammability** 3 **Stability** 0 **Physical and chemical properties** -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions	Evacuate personnel to safe areas. Use personal protective equipment as required. See section 8 for more information. Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. Keep people away from and upwind of spill/leak. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Pay attention to flashback. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material.
Other Information	Ventilate the area. Refer to protective measures listed in Sections 7 and 8.

Environmental precautions

Environmental precautions	Refer to protective measures listed in Sections 7 and 8. Prevent further leakage or spillage if safe to do so. Prevent product from entering drains.

Methods and material for containment and cleaning up

Methods for containment	Stop leak if you can do it without risk. Do not touch or walk through spilled material. A vapor suppressing foam may be used to reduce vapors. Dike far ahead of spill to collect runoff water. Keep out of drains, sewers, ditches and waterways. Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal.
Methods for cleaning up	Take precautionary measures against static discharges. Dam up. Soak up with inert absorbent material. Pick up and transfer to properly labeled containers.
Prevention of secondary hazards	Clean contaminated objects and areas thoroughly observing environmental regulations.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling	Use personal protection equipment. Avoid contact with skin and eyes. Avoid breathing vapors or mists. Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Use grounding and bonding connection when transferring this material to prevent static discharge, fire or explosion. Use with local exhaust ventilation. Use spark-proof tools and explosion-proof equipment. Keep in an area equipped with sprinklers. Use according to package label instructions. Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes or clothing. Do not eat, drink or smoke when using this product. Remove contaminated clothing and shoes. Take off contaminated clothing and wash before reuse.

Conditions for safe storage, including any incompatibilities

Storage Conditions

Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat, sparks, flame and other sources of ignition (i.e., pilot lights, electric motors and static electricity). Keep in properly labeled containers. Do not store near combustible materials. Keep in an area equipped with sprinklers. Store in accordance with the particular national regulations. Store in accordance with local regulations. Store locked up.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Chemical Name	ACGIH TLV	OSHA PEL
Petroleum; Crude oil 8002-05-9	-	TWA: 500 ppm TWA: 2000 mg/m³ (vacated) TWA: 400 ppm (vacated) TWA: 1600 mg/m³
Benzene 71-43-2	STEL: 2.5 ppm TWA: 0.5 ppm S*	TWA: 10 ppm applies to industry segments exempt from the benzene standard at 29 CFR 1910.1028 TWA: 1 ppm (vacated) TWA: 10 ppm unless specified in 1910.1028 (vacated) STEL: 50 ppm 10 min unless specified in 1910.1028 (vacated) Ceiling: 25 ppm unless specified in 1910.1028 Ceiling: 25 ppm STEL: 5 ppm see 29 CFR 1910.1028
N-hexane 110-54-3	TWA: 50 ppm S*	TWA: 500 ppm TWA: 1800 mg/m³ (vacated) TWA: 50 ppm (vacated) TWA: 180 mg/m³
Xylene 1330-20-7	STEL: 150 ppm TWA: 100 ppm	TWA: 100 ppm TWA: 435 mg/m³ (vacated) TWA: 100 ppm (vacated) TWA: 435 mg/m³ (vacated) STEL: 150 ppm (vacated) STEL: 655 mg/m³
Toluene 108-88-3	TWA: 20 ppm	TWA: 200 ppm (vacated) TWA: 100 ppm (vacated) TWA: 375 mg/m³ (vacated) STEL: 150 ppm (vacated) STEL: 560 mg/m³ Ceiling: 300 ppm
Naphthalene 91-20-3	TWA: 10 ppm S*	TWA: 10 ppm TWA: 50 mg/m³ (vacated) TWA: 10 ppm (vacated) TWA: 50 mg/m³ (vacated) STEL: 15 ppm (vacated) STEL: 75 mg/m³
Ethylbenzene 100-41-4	TWA: 20 ppm	TWA: 100 ppm TWA: 435 mg/m³ (vacated) TWA: 100 ppm (vacated) TWA: 435 mg/m³ (vacated) STEL: 125 ppm (vacated) STEL: 545 mg/m³
Cumene 98-82-8	TWA: 50 ppm	TWA: 50 ppm TWA: 245 mg/m³ (vacated) TWA: 50 ppm (vacated) TWA: 245 mg/m³ (vacated) S* S*
Hydrogen Sulfide	STEL: 5 ppm	(vacated) TWA: 10 ppm

7783-06-4	TWA: 1 ppm	(vacated) TWA: 14 mg/m^3 (vacated) STEL: 15 ppm (vacated) STEL: 21 mg/m^3 Ceiling: 20 ppm

S* - Potential exposure by cutaneous route

NOTE: Limits shown for guidance only. For additional information, OSHA's 1989 air contaminants standard exposure limits provided even though the limits were vacated in 1992. State, local or other agencies or advisory groups may have established more stringent limits. Follow applicable regulations.

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Tight sealing safety goggles.

Hand Protection Wear suitable gloves. Impervious gloves.

Skin and body protection Wear suitable protective clothing. Long sleeved clothing. Chemical resistant apron. Antistatic boots.

Respiratory protection When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. Use a NIOSH approved respirator when there is a potential for airborne concentrations to exceed occupational exposure limits. Refer to OSHA 29 CFR 1910.134, ANSI Z88.2, NIOSH Respirator Decision Logic, and the respirator manufacturer for additional guidance on respiratory protection selection. A Self-Contained Breathing Apparatus (SCBA) should be used for fire fighting. Use a NIOSH approved positive-pressure supplied air respirator if there is a potential for uncontrolled release, exposure levels are unknown, in oxygen deficient (less than 19.5% oxygen), or any other circumstance where an air-purifying respirator may not provide adequate protection.

General hygiene considerations Do not eat, drink or smoke when using this product. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product. Avoid contact with skin, eyes or clothing. Wear suitable gloves and eye/face protection.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State @20°C Liquid
Appearance Liquid
Odor Petroleum asphalt odor. Hydrogen sulfide (H2S) has a characteristic rotten egg odor with an odor threshold as low as 10 parts per billion or even less. However, this odor should not be used as a warning property because H2S can deaden the sense of smell. H2S concentrations can be measured with an H2S meter or colorimetric indicating tubes.
Color Dark yellow to brown or greenish black
Odor threshold Odor threshold varies with the composition of the crude oil

Property	Values	Remarks • Method
pH	Not applicable	
Melting point / freezing point	-30 °C / -22 °F	
Boiling range	300 °C	
Flash point	-7 °C / 19 °F	
Evaporation rate	No data available	
Flammability (solid, gas)	Flammable gas or vapor may be released by liquid	
Flammability Limit in Air %		

Upper flammability limit:	7
Lower flammability limit:	0.7
Vapor pressure	6 to 45
Vapor density	No data available
Relative density	0.8 to 1.0
Water solubility	1 to 2% by weight is maximum reported for soluble components of crude oil
Solubility in other solvents	No data available
Partition coefficient	2 to > 6
Autoignition temperature	No data available °C / °F
Decomposition temperature	No data available
Kinematic viscosity	5 to > 1300 mm2/s
Dynamic viscosity	No data available
Explosive properties	No data available
Oxidizing properties	No data available
Minimum Ignition Energy (mJ)	No data available
K_{st} (bar.m/s)	No data available
Softening point	No data available
VOC Content (%)	No data available
Density	No data available
Bulk density	Not applicable
Conductivity	No data available

10. STABILITY AND REACTIVITY

Reactivity	This product is non-reactive under normal conditions.
Chemical stability	Stable under recommended storage conditions.
Possibility of hazardous reactions	None under normal processing.
Conditions to avoid	Heat, flames and sparks.
Incompatible materials	Strong acids. Strong bases. Strong oxidizing agents.
Hazardous decomposition products	None under normal use conditions.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation	Specific test data for the substance or mixture is not available. May cause irritation of respiratory tract.
Eye contact	Specific test data for the substance or mixture is not available. Irritating to eyes. (based on components).
Skin contact	Specific test data for the substance or mixture is not available. Causes skin irritation. (based on components).
Ingestion	Specific test data for the substance or mixture is not available. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.

Information on toxicological effects

Symptoms Redness. May cause redness and tearing of the eyes.

Numerical measures of toxicity

Acute toxicity

The following values are calculated based on chapter 3.1 of the GHS document .

ATEmix (oral)	3,093.00 mg/kg
ATEmix (dermal)	1,836.00 mg/kg
ATEmix (inhalation-dust/mist)	8.00 mg/l
ATEmix (inhalation-vapor)	1,809.77 mg/l

Chemical Name	Oral LD50	LD50/dermal/rat - NO UNITS (Wizards mg/kg)	Inhalation LC50
Petroleum; Crude oil 8002-05-9	> 4300 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	-
Sulfur 7704-34-9	> 3000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 9.23 mg/L (Rat) 4 h
Benzene 71-43-2	= 1800 mg/kg (Rat) = 810 mg/kg (Rat)	> 8200 mg/kg (Rabbit)	= 44.66 mg/L (Rat) 4 h
N-hexane 110-54-3	= 25 g/kg (Rat)	= 3000 mg/kg (Rabbit)	= 48000 ppm (Rat) 4 h
Xylene 1330-20-7	= 3500 mg/kg (Rat)	> 1700 mg/kg (Rabbit) > 4350 mg/kg (Rabbit)	= 29.08 mg/L (Rat) 4 h = 5000 ppm (Rat) 4 h
Toluene 108-88-3	= 2600 mg/kg (Rat)	= 12000 mg/kg (Rabbit)	= 12.5 mg/L (Rat) 4 h
Naphthalene 91-20-3	= 1110 mg/kg (Rat) = 490 mg/kg (Rat)	= 1120 mg/kg (Rabbit) > 20 g/kg (Rabbit)	> 340 mg/m³ (Rat) 1 h
Ethylbenzene 100-41-4	= 3500 mg/kg (Rat)	= 15400 mg/kg (Rabbit)	= 17.4 mg/L (Rat) 4 h
Cumene 98-82-8	= 1400 mg/kg (Rat)	= 12300 µL/kg (Rabbit)	= 39000 mg/m³ (Rat) 4 h > 3577 ppm (Rat) 6 h
Hydrogen Sulfide 7783-06-4	-	-	= 700 mg/m³ (Rat) 4 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Chemical Name

Benzene

Benzene exposure may occur through inhalation, ingestion, skin absorption or eye contact. Benzene exposure can cause skin, eye and respiratory irritation. The most characteristic systemic effect resulting from high enough intermediate and chronic benzene exposure is arrested development of blood cells. Studies have linked overexposure to benzene to many hematological effects including aplastic anemia, pancytopenia, leukopenia, and myelodysplastic syndrome. In vivo and in vitro data from both humans and animals show that benzene and/or its metabolites are genotoxic. Studies in animals provide supporting evidence for the carcinogenicity of inhaled benzene. Epidemiological studies have reported a causal relationship between occupational benzene exposures and acute myelogenous leukemia. Some studies suggest associations between benzene exposure and non-Hodgkin's lymphoma, multiple myeloma, and other cancers. Benzene has been classified as carcinogenic to humans (Group 1) by IARC, and the ECHA C&L Inventory states it may cause cancer (Carc. 1B). IARC concluded that benzene causes acute myeloid leukemia and a positive association has been observed for acute lymphatic leukemia, chronic lymphatic leukemia, non-hodgkin lymphoma, and multiple myeloma. Human studies suggest that female fertility and menstrual cycles were effected by benzene exposure; however, due to uncertainties in exposure and limited data the studies were considered inconclusive. Developmental effects have been observed in animals including persistent hematopoietic anomalies. It has been suggested that the reported benzene fetotoxicity of decreased weight and skeletal variants is a function of maternal toxicity.

N-hexane

N-Hexane may be fatal if it is swallowed and enters the airways. Acute (short-term) dermal overexposure can cause skin and eye irritation in humans. Acute inhalation and oral exposures have caused systemic effects such as decreased body weight and respiratory effects, as well as reproductive and developmental effects in animals. Respiratory effects may include nose, throat, and lung irritation, coughing, wheezing, and shortness of breath. Acute overexposures may also cause headache, nausea, vomiting, dizziness, lightheadedness, loss of consciousness, coma, and death in human. Intermediate duration inhalation and oral exposures to relatively high concentrations (400-3,000 ppm) of n-hexane have led to nerve damage, paralysis, and/or deaths in rats. N-hexane may damage male

	reproductive glands. Intermediate-duration inhalation and oral exposure to high levels (1,000-10,000 ppm; 4,000 mg/kg/day) of n-hexane damages sperm-forming cells and testicles in rats. Chronic (long-term) inhalation of large amounts of n-hexane causes nerve damage and paralysis of the arms and legs in humans. Dermal effects, such as a skin rash, dryness, or redness can also occur following chronic overexposure. Chronic duration inhalation exposures in animals are not available.
Xylene	Mixed xylenes can cause skin, eye, and respiratory irritation. Both short- and long-term repeated exposures to high enough levels in humans have resulted in a variety of adverse nervous system effects that include headache, mental confusion, narcosis, equilibrium, impaired short-term memory, dizziness and tremors. Studies in laboratory animals indicate that xylene can cause changes in the liver and harmful effects on the kidneys, lungs, heart, and nervous system as well as hearing loss. The relevance of these observations to humans is not clear at this time. In general, developmental studies in animals reported adverse fetal effects only at concentrations that caused maternal toxicity. The relevance of these observations to humans is unclear at this time. The available data from in vitro and in vivo studies suggest that xylenes are not mutagenic and do not produce chromosomal abnormalities. Furthermore, rats exposed up to 500 mg/kg bw and mice exposed up to 1000 mg/kg bw mixed xylenes for 103 weeks showed no treatment-related increases in any tumor type. IARC has determined that the carcinogenicity of xylenes is not classifiable (Group 3).
Naphthalene	Acute (short term) exposure to large amounts of naphthalene may damage or destroy red blood cells, a condition termed hemolytic anemia. Symptoms of hemolytic anemia include fatigue, lack of appetite, restlessness, and pale skin. Acute inhalation or oral exposure to large amounts of naphthalene may also cause nausea, vomiting, diarrhea, blood in the urine, and a yellow color to the skin. Ingestion may result in death. Chronic (long term) exposure in rats and mice can lead to irritation and inflammation of their nose and lungs; nasal hyperplasia and metaplasia in respiratory and olfactory epithelium has been reported in studies in mice. Exposure to high enough levels may have effects on the blood, resulting in chronic hemolytic anemia, and effects on the eyes, resulting in the development of cataracts. Cancer from naphthalene exposure has been observed in animals, but not humans. IARC has classified naphthalene as possibly carcinogenic to humans (Group 2B), and the ECHA C&L Inventory reports that naphthalene is suspected of causing cancer (Carc. 2).
Ethylbenzene	Ethylbenzene may be fatal if it is swallowed and enters the airways. Short term (acute) exposure to ethylbenzene can cause eye, skin, and throat irritation. It may have effects on the central nervous system including dizziness, and at very high exposure, lowering on consciousness. Long-term exposures orally and by inhalation have been shown to cause damage to the inner ear and hearing in animals. Long term or repeated exposure to high enough levels of ethylbenzene may have effects on the kidneys and liver, resulting in impaired functions, and repeated contact with skin may cause dryness and cracking. Animal studies indicate some evidence of adverse effects on the liver, kidney, thyroid, and pituitary gland. In a 2-year inhalation study in mice and rats, the animals were exposed to 0, 75, 250, and 750 ppm ethylbenzene 6 hours/day, 5 days/week. Renal effects were observed in male rats (renal tubule hyperplasia) and female rats (renal tubule adenoma and adenoma or carcinoma) exposed to 750 ppm. The incidence of adenoma in the testes of males was significantly greater than in the control group and exceeded the historical control range for inhalation studies. The incidences of alveolar/bronchiolar adenoma was increased in males and the incidence of hepatocellular adenoma was increased in females. IARC has classified ethylbenzene as possibly carcinogenic to humans (Group 2B). Studies do not provide conclusive evidence of reproductive effects. In one study, developmental effects were reported in animals but only at very high doses (≥1000 ppm) that are likely to be toxic to the mother. The relevance of these findings to humans is not clear at this time.
Cumene	Cumene may be fatal if it is swallowed and enters the airways. Cumene targets the eyes, skin, respiratory system, and central nervous system. Short term (acute) exposure may result in irritation of the eyes, skin and mucous membranes, headache, narcosis, and coma. At high enough levels, repeated or prolonged contact with skin may cause dermatitis. Acute exposures to cumene in animal studies has been shown to result in neurotoxicological effects at concentrations > 500 ppm. A cumene concentration of 2,058 ppm has been shown to result in a 50% reduction in the respiratory rate of mice. In animals, an increase in organ weights, primarily the kidneys, are the most prominent effects observed in rodents

repeatedly exposed to cumene by either the oral or inhalation route. No adverse effects were observed in rat or rabbit fetuses whose mothers had been exposed to cumene during fetal development. Cumene is classified as possibly carcinogenic to humans by IARC (Group 2B).

Hydrogen Sulfide

Hydrogen Sulfide may be fatal if inhaled. The nervous system and respiratory tract are the main targets of hydrogen sulfide toxicity. Short term (acute) overexposure may cause irritation to the eyes, nose or throat. At high enough levels, effects on the nervous system include headaches, poor concentration, poor memory, unconsciousness, and death. Hydrogen sulfide has a strong odor that is characteristic of rotten eggs; however, the odor is not a reliable warning property as olfactory fatigue occurs at high levels. Respiratory distress or arrest can occur at high concentrations. Direct contact of the liquid with skin can cause frostbite; contact with the eyes can cause redness or severe burns. Cardiovascular effects have also been observed. NIOSH has determined that 100 ppm is immediately dangerous to life and health.

Health hazard and classification information

Skin Corrosion/Irritation Category Classification based on data available for ingredients. Irritating to skin.

Serious eye damage/eye irritation No information available.

No information available.

Germ cell mutagenicity Classification based on data available for ingredients. Contains a known or suspected mutagen. The table below indicates ingredients above the cut-off threshold considered as relevant which are listed as mutagenic.

Carcinogenicity Classification based on data available for ingredients. Contains a known or suspected carcinogen.

The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Petroleum; Crude oil 8002-05-9	A2	Group 3	Known	X
Benzene 71-43-2	A1	Group 1	Known	X
Xylene 1330-20-7	-	Group 3	-	-
Toluene 108-88-3	-	Group 3	-	-
Naphthalene 91-20-3	A3	Group 2B	Reasonably Anticipated	X
Ethylbenzene 100-41-4	A3	Group 2B	-	X
Cumene 98-82-8	-	Group 2B	Reasonably Anticipated	X

Reproductive toxicity Classification based on data available for ingredients. Contains a known or suspected reproductive toxin. The table below indicates ingredients above the cut-off threshold considered as relevant which are listed as reproductive toxins.

Target Organ Systemic Toxicant - Single Exposure No information available.

Target Organ Systemic Toxicant - Repeated Exposure Causes damage to organs through prolonged or repeated exposure.

Target organ effects liver, kidney, Respiratory system, Eyes, Skin, Central nervous system, blood, Peripheral Nervous System (PNS), bone marrow.

Aspiration hazard No information available.

12. ECOLOGICAL INFORMATION

Additional Ecological Information Release of this product should be prevented from contaminating soil and water and from entering drainage and sewer systems. U.S.A. regulations require reporting spills of this material that could reach any surface waters. The toll free number to the U.S. Coast Guard National Response Center is (800) 424-8802

Ecotoxicity Very toxic to aquatic life with long lasting effects.

Chemical Name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Petroleum; Crude oil 8002-05-9	-	258: 96 h Salmo gairdneri mg/L LC50 static	-	36: 24 h Daphnia magna mg/L EC50 0.26: 48 h Daphnia magna mg/L EC50 Static
Sulfur 7704-34-9	-	14: 96 h Lepomis macrochirus mg/L LC50 static 866: 96 h Brachydanio rerio mg/L LC50 static 180: 96 h Oncorhynchus mykiss mg/L LC50 static	-	-
Benzene 71-43-2	29: 72 h Pseudokirchneriella subcapitata mg/L EC50	10.7 - 14.7: 96 h Pimephales promelas mg/L LC50 flow-through 5.3: 96 h Oncorhynchus mykiss mg/L LC50 flow-through 22.49: 96 h Lepomis macrochirus mg/L LC50 static 28.6: 96 h Poecilia reticulata mg/L LC50 static 22330 - 41160: 96 h Pimephales promelas µg/L LC50 static 70000 - 142000: 96 h Lepomis macrochirus µg/L LC50 static	-	10: 48 h Daphnia magna mg/L EC50 8.76 - 15.6: 48 h Daphnia magna mg/L EC50 Static
N-hexane 110-54-3	-	2.1 - 2.98: 96 h Pimephales promelas mg/L LC50 flow-through	-	1000: 24 h Daphnia magna mg/L EC50
Xylene 1330-20-7	-	13.4: 96 h Pimephales promelas mg/L LC50 flow-through 780: 96 h Cyprinus carpio mg/L LC50 semi-static 780: 96 h Cyprinus carpio mg/L LC50 13.5 - 17.3: 96 h Oncorhynchus mykiss mg/L LC50 19: 96 h Lepomis macrochirus mg/L LC50 13.1 - 16.5: 96 h Lepomis macrochirus mg/L LC50 flow-through 23.53 - 29.97: 96 h Pimephales promelas mg/L LC50 static 30.26 - 40.75: 96 h Poecilia reticulata mg/L LC50 static 2.661 - 4.093: 96 h Oncorhynchus mykiss mg/L LC50 static 7.711 -	-	0.6: 48 h Gammarus lacustris mg/L LC50 3.82: 48 h water flea mg/L EC50

		9.591: 96 h Lepomis macrochirus mg/L LC50 static		
Toluene 108-88-3	12.5: 72 h Pseudokirchneriella subcapitata mg/L EC50 static 433: 96 h Pseudokirchneriella subcapitata mg/L EC50	12.6: 96 h Pimephales promelas mg/L LC50 static 5.89 - 7.81: 96 h Oncorhynchus mykiss mg/L LC50 flow-through 15.22 - 19.05: 96 h Pimephales promelas mg/L LC50 flow-through 5.8: 96 h Oncorhynchus mykiss mg/L LC50 semi-static 11.0 - 15.0: 96 h Lepomis macrochirus mg/L LC50 static 50.87 - 70.34: 96 h Poecilia reticulata mg/L LC50 static 14.1 - 17.16: 96 h Oncorhynchus mykiss mg/L LC50 static 28.2: 96 h Poecilia reticulata mg/L LC50 semi-static 54: 96 h Oryzias latipes mg/L LC50 static	-	11.5: 48 h Daphnia magna mg/L EC50 5.46 - 9.83: 48 h Daphnia magna mg/L EC50 Static
Naphthalene 91-20-3	0.4: 72 h Skeletonema costatum mg/L EC50	5.74 - 6.44: 96 h Pimephales promelas mg/L LC50 flow-through 31.0265: 96 h Lepomis macrochirus mg/L LC50 static 0.91 - 2.82: 96 h Oncorhynchus mykiss mg/L LC50 static 1.6: 96 h Oncorhynchus mykiss mg/L LC50 flow-through 1.99: 96 h Pimephales promelas mg/L LC50 static	-	1.96: 48 h Daphnia magna mg/L EC50 Flow through 1.09 - 3.4: 48 h Daphnia magna mg/L EC50 Static 2.16: 48 h Daphnia magna mg/L LC50
Ethylbenzene 100-41-4	438: 96 h Pseudokirchneriella subcapitata mg/L EC50 4.6: 72 h Pseudokirchneriella subcapitata mg/L EC50 1.7 - 7.6: 96 h Pseudokirchneriella subcapitata mg/L EC50 static 2.6 - 11.3: 72 h Pseudokirchneriella subcapitata mg/L EC50 static	4.2: 96 h Oncorhynchus mykiss mg/L LC50 semi-static 7.55 - 11: 96 h Pimephales promelas mg/L LC50 flow-through 9.6: 96 h Poecilia reticulata mg/L LC50 static 9.1 - 15.6: 96 h Pimephales promelas mg/L LC50 static 11.0 - 18.0: 96 h Oncorhynchus mykiss mg/L LC50 static 32: 96 h Lepomis macrochirus mg/L LC50 static	-	1.8 - 2.4: 48 h Daphnia magna mg/L EC50
Cumene 98-82-8	2.6: 72 h Pseudokirchneriella subcapitata mg/L EC50	6.04 - 6.61: 96 h Pimephales promelas mg/L LC50 flow-through 4.8: 96 h Oncorhynchus mykiss mg/L LC50 flow-through 5.1: 96 h Poecilia reticulata mg/L LC50 semi-static 2.7: 96 h Oncorhynchus mykiss	-	0.6: 48 h Daphnia magna mg/L EC50 7.9 - 14.1: 48 h Daphnia magna mg/L EC50 Static

		mg/L LC50 semi-static		
Hydrogen Sulfide 7783-06-4	-	0.016: 96 h Pimephales promelas mg/L LC50 flow-through 0.0448: 96 h Lepomis macrochirus mg/L LC50 flow-through	-	0.022: 96 h Gammarus pseudolimnaeus mg/L LC50

Persistence and degradability No information available.

Bioaccumulation There is no data for this product.

Component Information

Chemical Name	Partition coefficient
Benzene 71-43-2	2.1
Xylene 1330-20-7	2.77 - 3.15
Toluene 108-88-3	2.7
Naphthalene 91-20-3	3.6
Ethylbenzene 100-41-4	3.2
Cumene 98-82-8	3.7
Hydrogen Sulfide 7783-06-4	0.45

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Waste from residues/unused products Should not be released into the environment. Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Empty containers pose a potential fire and explosion hazard. Do not cut, puncture of weld containers.

US EPA Waste Number U019 U055 U135 U165 U220 U239 D001.

Chemical Name	RCRA	RCRA - Basis for Listing	RCRA - D Series Wastes	RCRA - U Series Wastes
Benzene 71-43-2	U019	Included in waste streams: F005, F024, F025, F037, F038, F039, K085, K104, K105, K141, K142, K143, K144, K145, K147, K151, K159, K169, K171, K172	0.5 mg/L regulatory level	U019
Xylene 1330-20-7	-	Included in waste stream: F039	-	U239
Toluene 108-88-3	U220	Included in waste streams: F005, F024, F025, F039, K015, K036, K037, K149, K151	-	U220
Polycyclic Aromatic Hydrocarbons 130498-29-2	-	Included in waste stream: K022	-	-
Naphthalene	U165	Included in waste	-	U165

91-20-3		streams: F024, F025, F034, F039, K001, K035, K060, K087, K145		
Ethylbenzene 100-41-4	-	Included in waste stream: F039	-	-
Cumene 98-82-8	-	-	-	U055
Hydrogen Sulfide 7783-06-4	U135	-	-	U135

Chemical Name	RCRA - Halogenated Organic Compounds	RCRA - P Series Wastes	RCRA - F Series Wastes	RCRA - K Series Wastes
Toluene 108-88-3	-	-	Toxic waste waste number F025 Waste description: Condensed light ends, spent filters and filter aids, and spent desiccant wastes from the production of certain chlorinated aliphatic hydrocarbons, by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution.	-
Naphthalene 91-20-3	-	-	Toxic waste waste number F025 Waste description: Condensed light ends, spent filters and filter aids, and spent desiccant wastes from the production of certain chlorinated aliphatic hydrocarbons, by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution.	-

California Hazardous Waste Status This product contains one or more substances that are listed with the State of California as a hazardous waste.

Chemical Name	California Hazardous Waste Status
Benzene 71-43-2	Toxic Ignitable
N-hexane 110-54-3	Toxic Ignitable
Xylene 1330-20-7	Toxic Ignitable

Toluene 108-88-3	Toxic Ignitable
Naphthalene 91-20-3	Toxic
Ethylbenzene 100-41-4	Toxic Ignitable
Cumene 98-82-8	Toxic Ignitable

14. TRANSPORT INFORMATION

DOT

UN/ID no	UN1267
Proper Shipping Name	PETROLEUM CRUDE OIL
Hazard Class	3
Packing group	I
Reportable Quantity (RQ)	Hydrogen sulfide H2S: RQ kg= 9080.00, Benzene: RQ kg= 151.33, Naphthalene: RQ kg= 4540.00, Xylenes mixed isomers: RQ kg= 4540.00
Special Provisions	357, T11, TP1, TP8, 144
Description	UN1267, Petroleum crude oil, 3, I, RQ
Emergency Response Guide Number	128

TDG

UN/ID no	UN1267
Proper Shipping Name	PETROLEUM CRUDE OIL
Hazard Class	3
Packing group	I
Description	UN1267, Petroleum crude oil, 3, I

MEX

UN/ID no	UN1267
Proper Shipping Name	PETROLEUM CRUDE OIL
Hazard Class	3
Special Provisions	357
Packing group	I
Description	UN1267, Petroleum crude oil, 3, I

IATA

UN/ID no	UN1267
Proper Shipping Name	PETROLEUM CRUDE OIL
Hazard Class	3
Packing group	I or II, depending on composition
Description	UN1267, Petroleum crude oil, 3, I

IMDG

UN/ID no	UN1267
Proper Shipping Name	PETROLEUM CRUDE OIL
Hazard Class	3
Packing group	I
EmS No.	F-E, S-E
Special Provisions	357
Description	UN1267, Petroleum crude oil, 3, I, (-7°C c.c.)

15. REGULATORY INFORMATION

International Inventories

TSCA	Not Listed
DSL/NDSL	Not Listed
ENCS	Not Listed
IECSC	Not Listed

KECL	Not Listed
PICCS	Not Listed
AICS	Not Listed

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

US Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories

Acute health hazard	Yes
Chronic Health Hazard	Yes
Fire hazard	Yes
Sudden release of pressure hazard	No
Reactive Hazard	No

CWA (Clean Water Act)
This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

Chemical Name	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Benzene 71-43-2	10 lb	X	X	X
Xylene 1330-20-7	100 lb	-	-	X
Toluene 108-88-3	1000 lb	X	X	X
Polycyclic Aromatic Hydrocarbons 130498-29-2	-	X	-	-
Naphthalene 91-20-3	100 lb	X	X	X
Ethylbenzene 100-41-4	1000 lb	X	X	X
Hydrogen Sulfide 7783-06-4	100 lb	-	-	X

CERCLA
The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts crude oil, fractions of crude oil, and products (both finished and intermediate) from the crude oil refining process and any indigenous components of such from the CERCLA Section 103 reporting requirements. However, other federal reporting requirements, including SARA Section 304, as well as the Clean Water Act may still apply.

US State Regulations

California Proposition 65
This product contains the following Proposition 65 chemicals.

Chemical Name	California Proposition 65
Benzene - 71-43-2	Carcinogen Developmental

	Male Reproductive
Naphthalene - 91-20-3	Carcinogen
Cumene - 98-82-8	Carcinogen
Ethylbenzene - 100-41-4	Carcinogen
Toluene - 108-88-3	Developmental

U.S. State Right-to-Know Regulations

US State Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
Petroleum; Crude oil 8002-05-9	X	X	X
Sulfur 7704-34-9	X	X	X
Benzene 71-43-2	X	X	X
N-hexane 110-54-3	X	X	X
Polycyclic Aromatic Hydrocarbons 130498-29-2	X	-	X
Xylene 1330-20-7	X	X	X
Ethylbenzene 100-41-4	X	X	X
Toluene 108-88-3	X	X	X
Naphthalene 91-20-3	X	X	X
Cumene 98-82-8	X	X	X
Hydrogen Sulfide 7783-06-4	X	X	X

16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

Revision Date 14-Jun-2017

Revision Note No information available.

Disclaimer

Tesoro Companies, Inc. (Tesoro) provides the information on this Safety Data Sheet (SDS) in order to meet its obligations under 29 CFR 1910.1200, and does not hereby make any guarantee of product specifications or suitability for any particular purpose. Tesoro does not assume any liability arising out of the use of Tesoro's product or the use of information provided on this SDS. The end user of the product has the responsibility for evaluating the adequacy of the data under the conditions of use, determining the safety, toxicity and suitability of the product under these conditions, and obtaining additional or clarifying information where uncertainty exists. No guarantee expressed or implied is made as to the effects of such use, the results to be obtained, or the safety and toxicity of the product in any specific application. Furthermore, the information herein is not represented as absolutely complete, since it is not practicable to provide all relevant information in the format of this document, since additional information may be necessary under exceptional conditions of use, and since Tesoro prepared this SDS based on information available on the date of its publication.

End of Safety Data Sheet

SAFETY DATA SHEET

Version 6.7
Revision Date 06/07/2021
Print Date 09/03/2022

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Hydrochloric acid

Product Number : H1758
Brand : Sigma
Index-No. : 017-002-01-X
CAS-No. : 7647-01-0

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 SPRUCE ST
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Corrosive to Metals (Category 1), H290
Skin corrosion (Category 1B), H314
Serious eye damage (Category 1), H318
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word Danger

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operates as MilliporeSigma in the US and Canada

Hazard statement(s)	
H290	May be corrosive to metals.
H314	Causes severe skin burns and eye damage.
H335	May cause respiratory irritation.
Precautionary statement(s)	
P234	Keep only in original container.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P330 + P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/ doctor.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER/ doctor.
P363	Wash contaminated clothing before reuse.
P390	Absorb spillage to prevent material damage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P406	Store in corrosive resistant container with a resistant inner liner.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Component		Classification	Concentration
Hydrochloric Acid			
CAS-No. EC-No. Index-No. Registration number	7647-01-0 231-595-7 017-002-01-X 01-2119484862-27-XXXX	Met. Corr. 1; Skin Corr. 1B; Eye Dam. 1; STOT SE 3; H290, H314, H318, H335 Concentration limits: >= 0.1 %: Met. Corr. 1, H290; >= 25 %: Skin Corr. 1B, H314; 10 - < 25 %: Skin Irrit. 2, H315; 10 - < 25 %: Eye Irrit. 2, H319; >= 10 %: STOT SE 3, H335;	>= 30 - < 50 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
First aiders need to protect themselves. Show this material safety data sheet to the doctor in attendance.

If inhaled
After inhalation: fresh air. Call in physician.

In case of skin contact
In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower. Call a physician immediately.

In case of eye contact
After eye contact: rinse out with plenty of water. Immediately call in ophthalmologist. Remove contact lenses.

If swallowed
After swallowing: make victim drink water (two glasses at most), avoid vomiting (risk of perforation). Call a physician immediately. Do not attempt to neutralise.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media
For this substance/mixture no limitations of extinguishing agents are given.

5.2 Special hazards arising from the substance or mixture
Hydrogen chloride gas
Hydrogen chloride gas
Not combustible.
Ambient fire may liberate hazardous vapours.

5.3 Advice for firefighters
Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information
Suppress (knock down) gases/vapors/mists with a water spray jet. Prevent fire extinguishing water from contaminating surface water or the ground water system.

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SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Advice for non-emergency personnel: Do not breathe vapors, aerosols. Avoid substance contact. Ensure adequate ventilation. Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up with liquid-absorbent and neutralising material (e.g. Chemizorb® H^+, Merck Art. No. 101595). Dispose of properly. Clean up affected area.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
No metal containers.
Tightly closed.
Storage class (TRGS 510): 8B: Non-combustible, corrosive hazardous materials

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Hydrochloric Acid	7647-01-0	C	2 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Not classifiable as a human carcinogen		

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		C	5 ppm 7 mg/m3	USA. NIOSH Recommended Exposure Limits
		C	5 ppm 7 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		C	5 ppm 7 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		PEL	0.3 ppm 0.45 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		C	2 ppm	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

8.2 Exposure controls

Appropriate engineering controls
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.

Personal protective equipment

Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Tightly fitting safety goggles

Skin protection
This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Splash contact
Material: Latex gloves
Minimum layer thickness: 0.6 mm
Break through time: 120 min
Material tested:Lapren® (KCL 706 / Aldrich Z677558, Size M)

Body Protection
Acid-resistant protective clothing

Respiratory protection
required when vapours/aerosols are generated.

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Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

Control of environmental exposure
Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid Color: light yellow
b)	Odor	pungent
c)	Odor Threshold	No data available
d)	pH	< 1 at 20 °C (68 °F)
e)	Melting point/freezing point	-30 °C (-22 °F)
f)	Initial boiling point and boiling range	> 100 °C > 212 °F - lit.
g)	Flash point	()Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapor pressure	227 hPa at 21.1 °C (70.0 °F) 547 hPa at 37.7 °C(99.9 °F)
l)	Vapor density	No data available
m)	Relative density	No data available
n)	Water solubility	soluble
o)	Partition coefficient: n-octanol/water	No data available
p)	Autoignition temperature	Not applicable
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

No data available

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SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
no information available

10.5 Incompatible materials
Bases, Amines, Alkali metals, Metals, permanganates, for example potassium permanganate, Fluorine, metal acetylides, hexalithium disilicideMetals

10.6 Hazardous decomposition products
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Mixture

Acute toxicity
Symptoms: If ingested, severe burns of the mouth and throat, as well as a danger of perforation of the esophagus and the stomach.
Symptoms: mucosal irritations, Cough, Shortness of breath, Possible damages:, damage of respiratory tract
Dermal: No data available

Skin corrosion/irritation
Mixture causes burns.

Serious eye damage/eye irritation
Mixture causes serious eye damage. Risk of blindness!

Respiratory or skin sensitization
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

IARC: No ingredient of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No ingredient of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure

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Mixture may cause respiratory irritation.

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

11.2 Additional Information

RTECS: MW4025000
Other dangerous properties can not be excluded.

Handle in accordance with good industrial hygiene and safety practice.

Components

Hydrochloric Acid

Acute toxicity
Oral: No data available
Inhalation: Cough Difficulty in breathing
Inhalation: absorption
Inhalation: Corrosive to respiratory system.
Symptoms: mucosal irritations, Cough, Shortness of breath, Inhalation may lead to the formation of oedemas in the respiratory tract., Possible damages:, damage of respiratory tract, tissue damage
Dermal: No data available

Skin corrosion/irritation
Skin - reconstructed human epidermis (RhE)
Result: Corrosive
(OECD Test Guideline 431)

Serious eye damage/eye irritation
Eyes - Bovine cornea
Result: Corrosive
(OECD Test Guideline 437)

Respiratory or skin sensitization
Maximization Test - Guinea pig
Result: negative
(OECD Test Guideline 406)

Germ cell mutagenicity
Test Type: Chromosome aberration test in vitro
Test system: Chinese hamster ovary cells
Result: Conflicting results have been seen in different studies.

Carcinogenicity
Carcinogenicity - Did not show carcinogenic effects in animal experiments. (IUCLID)

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
May cause respiratory irritation.
The substance or mixture is classified as specific target organ toxicant, single exposure, category 3 with respiratory tract irritation.

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Acute inhalation toxicity - mucosal irritations, Cough, Shortness of breath, Inhalation may lead to the formation of oedemas in the respiratory tract., Possible damages:, damage of respiratory tract, tissue damage

Specific target organ toxicity - repeated exposure
The substance or mixture is not classified as specific target organ toxicant, repeated exposure.**Aspiration hazard**
No aspiration toxicity classification

SECTION 12: Ecological information

12.1 Toxicity

Mixture
No data available

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
No data available

Components

Hydrochloric Acid
No data available

Toxicity to fish	LC50 - Gambusia affinis (Mosquito fish) - 282 mg/l - 96 h Remarks: (IUCLID)

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself. See www.retrologistik.com for processes regarding the return of chemicals and containers, or contact us there if you have further questions.

SECTION 14: Transport information

DOT (US)
UN number: 1789 Class: 8 Packing group: II
Proper shipping name: Hydrochloric acid

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Reportable Quantity (RQ):
Poison Inhalation Hazard: No

IMDG
UN number: 1789 Class: 8 Packing group: II EMS-No: F-A, S-B
Proper shipping name: HYDROCHLORIC ACID

IATA
UN number: 1789 Class: 8 Packing group: II
Proper shipping name: Hydrochloric acid

SECTION 15: Regulatory information

SARA 302 Components
This material does not contain any components with a section 302 EHS TPQ.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Hydrochloric Acid	7647-01-0	2013-02-08

SARA 311/312 Hazards
Acute Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Hydrochloric Acid	7647-01-0	2013-02-08

No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
water	7732-18-5	
Hydrochloric Acid	7647-01-0	2013-02-08

New Jersey Right To Know Components

	CAS-No.	Revision Date
water	7732-18-5	
Hydrochloric Acid	7647-01-0	2013-02-08

SECTION 16: Other information

Further information
The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to

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Version: 6.7 Revision Date: 06/07/2021 Print Date: 09/03/2022

The life science business of Merck KGaA, Darmstadt, Germany
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Hydrogen, compressed

Safety Data Sheet P-4604

This SDS conforms to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Issue date: 01/01/1980 Revision date: 01/24/2022 Supersedes: 01/28/2021 Version: 2.1

SECTION: 1. Product and company identification

1.1. Product identifier

Product form	:	Substance
Trade name	:	Hydrogen
Chemical name	:	Hydrogen
CAS-No.	:	1333-74-0
Formula	:	H2
Other means of identification	:	Dihydrogen, parahydrogen, refrigerant gas R702, water gas

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture	:	Industrial use; Use as directed.

1.3. Details of the supplier of the safety data sheet

Linde Inc.
10 Riverview Drive
Danbury, CT 06810-6268, USA
www.lindeus.com

Linde Inc. 1-844-44LINDE (1-844-445-4633)

1.4. Emergency telephone number

Emergency number : Onsite Emergency: 1-800-645-4633

CHEMTREC, 24hr/day 7days/week
— Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887
(collect calls accepted, Contract 17729)

SECTION 2: Hazard identification

2.1. Classification of the substance or mixture

GHS US classification

Simple asphyxiant	SIAS
Flam. Gas 1	H220
Press. Gas (Comp.)	H280

2.2. Label elements

GHS US labeling

Hazard pictograms (GHS US) :



GHS02 GHS04

Signal word (GHS US) : Danger

Hazard statements (GHS US) :
H220 - EXTREMELY FLAMMABLE GAS
H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED
OSHA-H01 - MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION.
CGA-HG04 - MAY FORM EXPLOSIVE MIXTURES WITH AIR
CGA-HG08 - BURNS WITH INVISIBLE FLAME.

Precautionary statements (GHS US) :
P202 - Do not handle until all safety precautions have been read and understood.
P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Heat, Open flames, Sparks, Hot surfaces
P271+P403 - Use and store only outdoors or in a well-ventilated place.
P377 - LEAKING GAS FIRE: Do not extinguish, unless leak can be stopped safely.
P381 - Eliminate all ignition sources if safe to do so.
P304, P340, P313 - IF INHALED: Remove person to fresh air and keep comfortable for

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breathing. Get medical advice/attention.
CGA-PG05 - Use a back flow preventive device in the piping.
CGA-PG10 - Use only with equipment rated for cylinder pressure.
CGA-PG12 - Do not open valve until connected to equipment prepared for use.
CGA-PG06 - Close valve after each use and when empty.
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F).

2.3. Other hazards

Other hazards which do not result in classification : None.

2.4. Unknown acute toxicity (GHS US)

No data available

SECTION 3: Composition/Information on ingredients

3.1. Substances

Name : Hydrogen, compressed

CAS-No. : 1333-74-0

Name	Product identifier	%
Hydrogen	(CAS-No.) 1333-74-0	99.5 – 100

3.2. Mixtures

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remove to fresh air and keep at rest in a position comfortable for breathing. If not breathing, give artificial respiration. If breathing is difficult, trained personnel should give oxygen. Call a physician.

First-aid measures after skin contact : Adverse effects not expected from this product.

First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Contact an ophthalmologist immediately.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects, both acute and delayed

No additional information available

4.3. Indication of any immediate medical attention and special treatment needed

None.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Carbon dioxide, dry chemical powder, water spray, fog.

5.2. Special hazards arising from the substance or mixture

Fire hazard : EXTREMELY FLAMMABLE GAS. The hydrogen flame is nearly invisible. Hydrogen has a low ignition energy; escaping hydrogen gas may ignite spontaneously. A fireball forms if the gas cloud ignites immediately after release. Hydrogen forms explosive mixtures with air and oxidizing agents.

Explosion hazard : EXTREMELY FLAMMABLE GAS. Forms explosive mixtures with air and oxidizing agents.

Reactivity : No reactivity hazard other than the effects described below.

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5.3. Advice for firefighters

Firefighting instructions : If venting or leaking gas catches fire, do not extinguish flames. Flammable vapors may spread from leak, creating an explosive reignition hazard. Vapors can be ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharge, or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering an area, especially a confined area, check the atmosphere with an appropriate device.

Evacuate all personnel from the danger area. Use self-contained breathing apparatus (SCBA) and protective clothing. Immediately cool containers with water from maximum distance. Stop flow of gas if safe to do so, while continuing cooling water spray. Remove ignition sources if safe to do so. Remove containers from area of fire if safe to do so. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1910 Subpart L—Fire Protection.

Protection during firefighting : Compressed gas: asphyxiant. Suffocation hazard by lack of oxygen.

Special protective equipment for fire fighters : Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters.

Specific methods : Use fire control measures appropriate for the surrounding fire. Exposure to fire and heat radiation may cause gas containers to rupture. Cool endangered containers with water spray jet from a protected position. Prevent water used in emergency cases from entering sewers and drainage systems.

Stop flow of product if safe to do so.

Use water spray or fog to knock down fire fumes if possible.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : **Danger:** EXTREMELY FLAMMABLE GAS. Forms explosive mixtures with air and oxidizing agents. See section 5. Evacuate personnel to a safe area. Appropriate self-contained breathing apparatus may be required. Approach suspected leak area with caution. Remove all sources of ignition. if safe to do so. Reduce gas with fog or fine water spray. Stop flow of product if safe to do so. Ventilate area or move container to a well-ventilated area. Flammable gas may spread from leak. Before entering the area, especially a confined area, check the atmosphere with an appropriate device.

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

Prevent waste from contaminating the surrounding environment. Prevent soil and water pollution. Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

6.3. Methods and material for containment and cleaning up

No additional information available

6.4. Reference to other sections

See also sections 8 and 13.

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SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only non-sparking tools. Use only explosion-proof equipment.

Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g, wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store only where temperature will not exceed 125°F (52°C). Post “No Smoking/No Open Flames” signs in storage and use areas. There must be no sources of ignition. Separate packages and protect against potential fire and/or explosion damage following appropriate codes and requirements (e.g, NFPA 30, NFPA 55, NFPA 70, and/or NFPA 221 in the U.S.) or according to requirements determined by the Authority Having Jurisdiction (AHJ). Always secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand when the container is not in use. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods. For other precautions in using this product, see section 16.

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

7.3. Specific end use(s)

None.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Hydrogen, compressed (1333-74-0)	
ACGIH	Not established
USA OSHA	Not established

Hydrogen (1333-74-0)		
ACGIH	Remark (ACGIH)	Simple asphyxiant
USA OSHA	Not established	

8.2. Exposure controls

Appropriate engineering controls : Use an explosion-proof local exhaust system. Local exhaust and general ventilation must be adequate to meet exposure standards. MECHANICAL (GENERAL): **Inadequate - Use only in a closed system.** Use explosion proof equipment and lighting.

Eye protection : Wear safety glasses with side shields.

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Respiratory protection	:	When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure. For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).
Thermal hazard protection	:	None necessary.
Other information	:	Consider the use of flame resistant anti-static safety clothing. Wear safety shoes while handling containers.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Gas
Appearance	:	Colorless gas.
Molecular mass	:	2 g/mol
Color	:	Colorless.
Odor	:	Odorless.
Odor threshold	:	No data available
pH	:	Not applicable.
Relative evaporation rate (butyl acetate=1)	:	No data available
Relative evaporation rate (ether=1)	:	Not applicable.
Melting point	:	-259.2 °C (-434.56°F)
Freezing point	:	No data available
Boiling point	:	-252.9 °C (-422.97°F)
Flash point	:	No data available
Critical temperature	:	-239.9 °C (-399.82°F)
Auto-ignition temperature	:	566 °C (1051°F)
Decomposition temperature	:	No data available
Flammability (solid, gas)	:	No data available
Vapor pressure	:	Not applicable.
Relative vapor density at 20 °C	:	No data available
Relative density	:	No data available
Density	:	0.089 g/l (0.0056 lb/ft3) (at STP = 0°C and 1atm)
Relative gas density	:	0.07
Solubility	:	Water: 1.6 mg/l
Partition coefficient n-octanol/water (Log Pow)	:	Not applicable.
Partition coefficient n-octanol/water (Log Kow)	:	Not applicable.
Viscosity, kinematic	:	Not applicable.
Viscosity, dynamic	:	Not applicable.
Explosive properties	:	Not applicable.
Oxidizing properties	:	None.
Explosion limits	:	4 – 77 vol %

9.2. Other information

Gas group	:	Compressed gas
Additional information	:	BURNS WITH INVISIBLE FLAME.

SECTION 10: Stability and reactivity

10.1. Reactivity

No reactivity hazard other than the effects described below.

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10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Can form explosive mixture with air. May react violently with oxidants.

10.4. Conditions to avoid

Keep away from heat/sparks/open flames/hot surfaces. – No smoking.

10.5. Incompatible materials

Oxidizing agents. Lithium. Halogens.

10.6. Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Hydrogen, compressed (\f)1333-74-0	
LC50 Inhalation - Rat [ppm]	> 15000 ppm/1h

Skin corrosion/irritation : Not classified

pH: Not applicable.

Serious eye damage/irritation : Not classified

pH: Not applicable.

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

STOT-single exposure : Not classified

STOT-repeated exposure : Not classified

Aspiration hazard : Not classified

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : No ecological damage caused by this product.

12.2. Persistence and degradability

Hydrogen, compressed (1333-74-0)	
Persistence and degradability	No ecological damage caused by this product.

Hydrogen (1333-74-0)	
Persistence and degradability	No ecological damage caused by this product.

12.3. Bioaccumulative potential

Hydrogen, compressed (1333-74-0)	
BCF - Fish [1]	(no bioaccumulation expected)
Partition coefficient n-octanol/water (Log Pow)	Not applicable.
Partition coefficient n-octanol/water (Log Kow)	Not applicable.
Bioaccumulative potential	No ecological damage caused by this product.

Hydrogen (1333-74-0)	
BCF - Fish [1]	(no bioaccumulation expected)
Partition coefficient n-octanol/water (Log Pow)	Not applicable.

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Hydrogen (1333-74-0)	
Partition coefficient n-octanol/water (Log Kow)	Not applicable.
Bioaccumulative potential	No ecological damage caused by this product.

12.4. Mobility in soil

Hydrogen, compressed (1333-74-0)	
Mobility in soil	No data available.
Ecology - soil	No ecological damage caused by this product.

Hydrogen (1333-74-0)	
Mobility in soil	No data available.
Ecology - soil	No ecological damage caused by this product.

12.5. Other adverse effects

Effect on ozone layer : None.

Effect on the global warming : No known effects from this product.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product/Packaging disposal recommendations : Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

SECTION 14: Transport information

In accordance with DOT

Transport document description (DOT) : UN1049 Hydrogen, compressed, 2.1

UN-No.(DOT) : UN1049

Proper Shipping Name (DOT) : Hydrogen, compressed

Class (DOT) : 2.1 - Class 2.1 - Flammable gas 49 CFR 173.115

Hazard labels (DOT) : 2.1 - Flammable gas



DOT Special Provisions (49 CFR 172.102) : N89 - When steel UN pressure receptacles are used, only those bearing the “H” mark are authorized.

Additional information

Emergency Response Guide (ERG) Number : 115 (UN1049)

Other information : No supplementary information available.

Special transport precautions : Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers: - Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.

Transport by sea

UN-No. (IMDG) : 1049

Proper Shipping Name (IMDG) : HYDROGEN, COMPRESSED

Class (IMDG) : 2 - Gases

Division (IMDG) : 2.1 - Flammable gases

MFAG-No : 115

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Air transport

UN-No. (IATA)	:	1049
Proper Shipping Name (IATA)	:	Hydrogen, compressed
Class (IATA)	:	2 - Gases
Civil Aeronautics Law	:	Gases under pressure/Gases flammable under pressure

SECTION 15: Regulatory information

15.1. US Federal regulations

Hydrogen, compressed (1333-74-0)
Listed on the United States TSCA (Toxic Substances Control Act) inventory

All components of this product are listed on the Toxic Substances Control Act (TSCA) inventory.

15.2. International regulations

CANADA

Hydrogen, compressed (1333-74-0)
Listed on the Canadian DSL (Domestic Substances List)

Hydrogen (1333-74-0)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

Hydrogen, compressed (1333-74-0)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

15.2.2. National regulations

Hydrogen, compressed (1333-74-0)
Listed introduction on Australian Industrial Chemicals Introduction Scheme (AICIS Inventory) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on KECL/KECI (Korean Existing Chemicals Inventory) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Listed on INSQ (Mexican National Inventory of Chemical Substances) Listed on the TCSI (Taiwan Chemical Substance Inventory)

15.3. US State regulations

Hydrogen, compressed(1333-74-0)	
U.S. - California - Proposition 65 - Carcinogens List	No
U.S. - California - Proposition 65 - Developmental Toxicity	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer, developmental and/or reproductive harm

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Hydrogen (1333-74-0)				
U.S. - California - Proposition 65 - Carcinogens List	U.S. - California - Proposition 65 - Developmental Toxicity	U.S. - California - Proposition 65 - Reproductive Toxicity - Female	U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No significant risk level (NSRL)
No	No	No	No	

Hydrogen (1333-74-0)
U.S. - Massachusetts - Right To Know List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List

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Hydrogen, compressed

Safety Data Sheet P-4604

This SDS conforms to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Issue date: 01/01/1980 Revision date: 01/24/2022 Supersedes: 01/28/2021 Version: 2.1

SECTION 16: Other information

Other information : When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product.

Linde asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Linde Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Linde Inc, it is the user's obligation to determine the conditions of safe use of the product.

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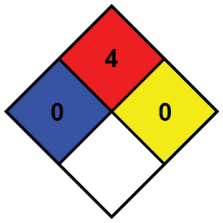
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Revision date : 01/24/2022

NFPA health hazard : 0 - Materials that, under emergency conditions, would offer no hazard beyond that of ordinary combustible materials.

NFPA fire hazard : 4 - Materials that rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and burn readily.

NFPA instability : 0 - Material that in themselves are normally stable, even under fire conditions.



SDS US (GHS HazCom 2012) - Linde 2022

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

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SAFETY DATA SHEET

Hydrogen Sulfide

Airgas
an Air Liquide company

Section 1. Identification

GHS product identifier : Hydrogen Sulfide

Chemical name : hydrogen sulphide

Other means of identification : Hydrogen sulfide; Sulfuretted hydrogen; Sewer gas; Hydrosulfuric acid; dihydrogen sulfide; hydrosulphuric acid; sulphuretted hydrogen; HYDROGEN SULFIDE H2S; Sulfur hydride; Hydrogen sulfide (H2S); Sulfuric acid

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

Synonym : Hydrogen sulfide; Sulfuretted hydrogen; Sewer gas; Hydrosulfuric acid; dihydrogen sulfide; hydrosulphuric acid; sulphuretted hydrogen; HYDROGEN SULFIDE H2S; Sulfur hydride; Hydrogen sulfide (H2S); Sulfuric acid

SDS # : 001029

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas
ACUTE TOXICITY (inhalation) - Category 2
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3
AQUATIC HAZARD (ACUTE) - Category 1

GHS label elements

Hazard pictograms :



Signal word : Danger

Hazard statements : Extremely flammable gas.
Contains gas under pressure; may explode if heated.
Fatal if inhaled.
May cause respiratory irritation.
Very toxic to aquatic life.
Extended exposure to gas reduces the ability to smell sulfides.
May form explosive mixtures with air.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Do not depend on odor to detect presence of gas. Approach suspected leak area with caution.

Section 2. Hazards identification

Prevention : In case of inadequate ventilation wear respiratory protection. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only outdoors or in a well-ventilated area. Avoid release to the environment. Do not breathe gas.

Response : Collect spillage. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. In case of leakage, eliminate all ignition sources. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor.

Storage : Store locked up. Store in a well-ventilated place. Keep container tightly closed. Protect from sunlight.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : hydrogen sulphide

Other means of identification : Hydrogen sulfide; Sulfuretted hydrogen; Sewer gas; Hydrosulfuric acid; dihydrogen sulfide; hydrosulphuric acid; sulphuretted hydrogen; HYDROGEN SULFIDE H2S; Sulfur hydride; Hydrogen sulfide (H2S); Sulfuric acid

Product code : 001029

CAS number/other identifiers

CAS number : 7783-06-4

Ingredient name	%	CAS number
hydrogen sulfide	100	7783-06-4

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Get medical attention immediately. Call a poison center or physician. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Section 4. First aid measures

Inhalation : Fatal if inhaled. May cause respiratory irritation.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : Adverse symptoms may include the following:, respiratory tract irritation, coughing

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. This material is very toxic to aquatic life. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
sulfur oxides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Do not breathe gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

Section 6. Accidental release measures

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Use only non-sparking tools. Avoid release to the environment. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Do not breathe gas.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Store locked up. Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
hydrogen sulfide	**ACGIH TLV (United States, 3/2019).** STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours. **NIOSH REL (United States, 10/2016).** CEIL: 15 mg/m³ 10 minutes. CEIL: 10 ppm 10 minutes. **OSHA PEL 1989 (United States, 3/1989).** STEL: 21 mg/m³ 15 minutes. STEL: 15 ppm 15 minutes. TWA: 14 mg/m³ 8 hours.

Section 8. Exposure controls/personal protection

	TWA: 10 ppm 8 hours. **OSHA PEL Z2 (United States, 2/2013).** AMP: 50 ppm 10 minutes. CEIL: 20 ppm

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Compressed gas.]

Color : Colorless.

Odor : Rotten eggs.

Odor threshold : Not available.

pH : Not available.

Melting point : -82°C (-115.6°F)

Section 9. Physical and chemical properties

Boiling point	:	-60°C (-76°F)
Critical temperature	:	100.5°C (212.9°F)
Flash point	:	Not available.
Evaporation rate	:	Not available.
Flammability (solid, gas)	:	Not available.
Lower and upper explosive (flammable) limits	:	Lower: 4.3% Upper: 45%
Vapor pressure	:	252 (psig)
Vapor density	:	1.19 (Air = 1)
Specific Volume (ft^3/lb)	:	11.236
Gas Density (lb/ft^3)	:	0.089
Relative density	:	Not applicable.
Solubility	:	Not available.
Solubility in water	:	5 g/l
Partition coefficient: n-octanol/water	:	Not available.
Auto-ignition temperature	:	270°C (518°F)
Decomposition temperature	:	Not available.
Viscosity	:	Not applicable.
Flow time (ISO 2431)	:	Not available.
Molecular weight	:	34.08 g/mole

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials : Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
hydrogen sulfide	LC50 Inhalation Gas.	Rat	712 ppm	1 hours

Irritation/Corrosion

Not available.

Sensitization

Section 11. Toxicological information

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
hydrogen sulfide	Category 3	-	Respiratory tract irritation

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : Fatal if inhaled. May cause respiratory irritation.

Skin contact : No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : Adverse symptoms may include the following:, respiratory tract irritation, coughing

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Section 11. Toxicological information

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value
Inhalation (gases)	356 ppm

Other information : IDLH : 100 ppm

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
hydrogen sulfide	Acute EC50 62 µg/l Fresh water Acute LC50 2 µg/l Fresh water	Crustaceans - Gammarus pseudolimnaeus Fish - Coregonus clupeaformis - Yolk-sac fry	2 days 96 hours

Persistence and degradability

Not available.

Bioaccumulative potential

Not available.

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

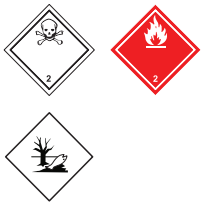
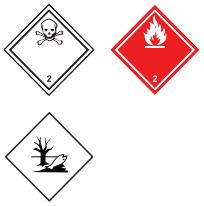
Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

United States - RCRA Toxic hazardous waste "U" List

Ingredient	CAS #	Status	Reference number
Hydrogen sulfide; Hydrogen sulfide H2S	7783-06-4	Listed	U135

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1053	UN1053	UN1053	UN1053	UN1053
UN proper shipping name	HYDROGEN SULFIDE	HYDROGEN SULFIDE; OR HYDROGEN SULPHIDE	HYDROGEN SULFIDE	HYDROGEN SULPHIDE	HYDROGEN SULPHIDE
Transport hazard class(es)	2.3 (2.1) 	2.3 (2.1) 	2.3 (2.1) 	2.3 (2.1) 	2.3 (2.1) 
Packing group	-	-	-	-	-
Environmental hazards	No.	Yes.	Yes. The environmentally hazardous substance mark is not required.	Yes.	Yes. The environmentally hazardous substance mark is not required.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification : Toxic - Inhalation hazard Zone B
Reportable quantity 100 lbs / 45.4 kg. Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.
Limited quantity Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: Forbidden.
Special provisions 2, B9, B14

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2), 2.13-2.17 (Class 2), 2.7 (Marine pollutant mark).
The marine pollutant mark is not required when transported by road or rail.
Explosive Limit and Limited Quantity Index 0
ERAP Index 0
Passenger Carrying Vessel Index Forbidden
Passenger Carrying Road or Rail Index Forbidden

IMDG : The marine pollutant mark is not required when transported in sizes of ≤5 L or ≤5 kg.

IATA : The environmentally hazardous substance mark may appear if required by other transportation regulations.
Quantity limitation Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: Forbidden.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to IMO instruments : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

Clean Water Act (CWA) 311: hydrogen sulphide

Clean Air Act (CAA) 112 regulated toxic substances: hydrogen sulphide

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

Name	%	EHS	SARA 302 TPQ		SARA 304 RQ	
			(lbs)	(gallons)	(lbs)	(gallons)
hydrogen sulfide	100	Yes.	500	-	100	-

SARA 304 RQ : 100 lbs / 45.4 kg

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	hydrogen sulphide	7783-06-4	100
Supplier notification	hydrogen sulphide	7783-06-4	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

California Prop. 65

This product does not require a Safe Harbor warning under California Prop. 65.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

Section 15. Regulatory information

UNECE Aarhus Protocol on POPs and Heavy Metals

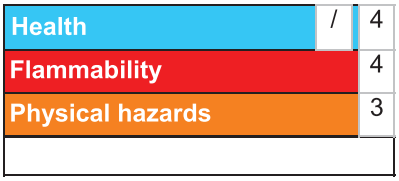
Not listed.

Inventory list

Australia	:	This material is listed or exempted.
Canada	:	This material is listed or exempted.
China	:	This material is listed or exempted.
Europe	:	This material is listed or exempted.
Japan	:	**Japan inventory (ENCS)**: This material is listed or exempted. **Japan inventory (ISHL)**: Not determined.
New Zealand	:	This material is listed or exempted.
Philippines	:	This material is listed or exempted.
Republic of Korea	:	This material is listed or exempted.
Taiwan	:	This material is listed or exempted.
Thailand	:	Not determined.
Turkey	:	Not determined.
United States	:	This material is active or exempted.
Viet Nam	:	This material is listed or exempted.

Section 16. Other information

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Section 16. Other information

Classification	Justification
FLAMMABLE GASES - Category 1	Expert judgment
GASES UNDER PRESSURE - Liquefied gas	Expert judgment
ACUTE TOXICITY (inhalation) - Category 2	On basis of test data
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3	Expert judgment
AQUATIC HAZARD (ACUTE) - Category 1	Expert judgment

History

Date of printing : 2/11/2021

Date of issue/Date of revision : 2/11/2021

Date of previous issue : 11/30/2017

Version : 1.01

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Isobutylene

Safety Data Sheet P-4614

This SDS conforms to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Issue date: 01/01/1979 Revision date: 03/11/2022 Supersedes: 01/22/2021 Version: 1.1

SECTION: 1. Product and company identification

1.1. Product identifier

Product form	:	Substance
Substance name	:	Isobutylene
Chemical name	:	2-methylpropene
CAS-No.	:	115-11-7
Formula	:	C4H8 / CH2=C(CH3)2
Other means of identification	:	Isobutene, 2-methylpropene

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture	:	Industrial use; Use as directed.

1.3. Details of the supplier of the safety data sheet

Linde Inc.
10 Riverview Drive
Danbury, CT 06810-6268, USA
www.lindeus.com

Linde Inc. 1-844-44LINDE (1-844-445-4633)

1.4. Emergency telephone number

Emergency number : Onsite Emergency: 1-800-645-4633

CHEMTREC, 24hr/day 7days/week
— Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887
(collect calls accepted, Contract 17729)

SECTION 2: Hazard identification

2.1. Classification of the substance or mixture

GHS US classification

Simple asphyxiant	SIAS
Flam. Gas 1	H220
Press. Gas (Liq.)	H280

2.2. Label elements

GHS US labeling

Hazard pictograms (GHS US) :



GHS02 GHS04

Signal word (GHS US) : Danger

Hazard statements (GHS US) :
H220 - EXTREMELY FLAMMABLE GAS
H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED
OSHA-H01 - MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION.
CGA-HG04 - MAY FORM EXPLOSIVE MIXTURES WITH AIR
CGA-HG01 - MAY CAUSE FROSTBITE.

Precautionary statements (GHS US) :
P202 - Do not handle until all safety precautions have been read and understood.
P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Heat, Open flames, Sparks, Hot surfaces
P271+P403 - Use and store only outdoors or in a well-ventilated place.
P280 - Wear protective gloves/protective clothing/eye protection/face protection.
P377 - LEAKING GAS FIRE: Do not extinguish, unless leak can be stopped safely.
P381 - Eliminate all ignition sources if safe to do so.

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CGA-PG05 - Use a back flow preventive device in the piping.
CGA-PG12 - Do not open valve until connected to equipment prepared for use.
CGA-PG06 - Close valve after each use and when empty.
CGA-PG10 - Use only with equipment rated for cylinder pressure.
CGA-PG11 - Never put cylinders into unventilated areas of passenger vehicles.
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F).
P304 - IF INHALED:
P340 - Remove person to fresh air and keep comfortable for breathing.
P313 - Get medical advice/attention.
P302 - IF ON SKIN:
P336 - Thaw frosted parts with lukewarm water. Do not rub affected area.
P315 - Get immediate medical advice/attention.

2.3. Other hazards

Other hazards which do not result in classification : None.

2.4. Unknown acute toxicity (GHS US)

No data available

SECTION 3: Composition/Information on ingredients

3.1. Substances

Name	Product identifier	%
Isobutylene (Main constituent)	(CAS-No.) 115-11-7	100

3.2. Mixtures

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remove to fresh air and keep at rest in a position comfortable for breathing. If not breathing, give artificial respiration. If breathing is difficult, trained personnel should give oxygen. Call a physician.

First-aid measures after skin contact : The liquid may cause frostbite. For exposure to liquid, immediately warm frostbite area with warm water not to exceed 105°F (41°C). Water temperature should be tolerable to normal skin. Maintain skin warming for at least 15 minutes or until normal coloring and sensation have returned to the affected area. In case of massive exposure, remove clothing while showering with warm water. Seek medical evaluation and treatment as soon as possible.

First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Contact an ophthalmologist immediately.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects, both acute and delayed

No additional information available

4.3. Indication of any immediate medical attention and special treatment needed

None.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Carbon dioxide, Dry chemical, Water spray or fog.

5.2. Special hazards arising from the substance or mixture

Fire hazard : EXTREMELY FLAMMABLE GAS. If venting or leaking gas catches fire, do not extinguish flames. Flammable vapors may spread from leak, creating an explosive reignition hazard. Vapors can be ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharge, or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering an area, especially a confined area, check the atmosphere with an appropriate device.

Explosion hazard : EXTREMELY FLAMMABLE GAS. Forms explosive mixtures with air and oxidizing agents.

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Reactivity : No reactivity hazard other than the effects described in sub-sections below.

5.3. Advice for firefighters

Firefighting instructions : **Danger: FLAMMABLE LIQUID AND VAPOR.** Evacuate all personnel from danger area. Use self-contained breathing apparatus. Immediately cool surrounding containers with water spray from maximum distance, taking care not to extinguish flames. Avoid spreading burning liquid with water. Remove ignition sources if safe to do so. If flames are accidentally extinguished, explosive reignition may occur. Reduce vapors with fine water spray or fog. Stop flow of liquid if safe to do so, while continuing cooling water spray. Remove all containers from area of fire if safe to do so. Allow fire to burn out. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1919 Subpart L - Fire Protection.

Special protective equipment for fire fighters : Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters.

Other information : Containers are equipped with a pressure relief device. (Exceptions may exist where authorized by DOT.).

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : **Danger: Flammable, liquefied gas.** FORMS EXPLOSIVE MIXTURES WITH AIR. Immediately evacuate all personnel from danger area. Use self-contained breathing apparatus where needed. Remove all sources of ignition if safe to do so. Reduce vapors with fog or fine water spray, taking care not to spread liquid with water. Shut off flow if safe to do so. Ventilate area or move container to a well-ventilated area. Flammable vapors may spread from leak and could explode if reignited by sparks or flames. Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with an appropriate device.

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

Try to stop release. Prevent waste from contaminating the surrounding environment. Prevent soil and water pollution. Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

6.3. Methods and material for containment and cleaning up

No additional information available

6.4. Reference to other sections

See also sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only non-sparking tools. Use only explosion-proof equipment.

Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g, wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

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7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store only where temperature will not exceed 125°F (52°C). Post “No Smoking/No Open Flames” signs in storage and use areas. There must be no sources of ignition. Separate packages and protect against potential fire and/or explosion damage following appropriate codes and requirements (e.g, NFPA 30, NFPA 55, NFPA 70, and/or NFPA 221 in the U.S.) or according to requirements determined by the Authority Having Jurisdiction (AHJ). Always secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand when the container is not in use. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods. For other precautions in using this product, see section 16.

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

7.3. Specific end use(s)

None.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Isobutylene (115-11-7)		
ACGIH	ACGIH OEL TWA [ppm]	250 ppm

8.2. Exposure controls

Appropriate engineering controls : Use an explosion-proof local exhaust system. Local exhaust and general ventilation must be adequate to meet exposure standards. MECHANICAL (GENERAL): **Inadequate - Use only in a closed system.** Use explosion proof equipment and lighting.

Eye protection : Wear safety glasses when handling cylinders; vapor-proof goggles and a face shield during cylinder changeout or whenever contact with product is possible. Select eye protection in accordance with OSHA 29 CFR 1910.133.

Skin and body protection : Wear metatarsal shoes and work gloves for cylinder handling, and protective clothing where needed. Wear appropriate chemical gloves during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.

Respiratory protection : When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure. For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

Thermal hazard protection : Wear cold insulating gloves when transfilling or breaking transfer connections.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Gas

Molecular mass : 56 g/mol

Color : Colorless.

Odor : Poor warning properties at low concentrations. Sweetish.

Odor threshold : Odor threshold is subjective and inadequate to warn for overexposure.

pH : Not applicable.

Relative evaporation rate (butyl acetate=1) : No data available

Relative evaporation rate (ether=1) : Not applicable.

Melting point : -140.3 °C

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Freezing point	:	No data available
Boiling point	:	-6.9 °C
Flash point	:	-80 °C (closed cup)
Critical temperature	:	144.7 °C
Auto-ignition temperature	:	465 °C
Decomposition temperature	:	No data available
Flammability (solid, gas)	:	1.8 – 8.8 vol %
Vapor pressure	:	260 kPa
Critical pressure	:	4000 kPa
Relative vapor density at 20 °C	:	No data available
Relative density	:	0.63
Density	:	0.599 g/cm³ (at 20 °C)
Relative gas density	:	2
Solubility	:	Water: 388 mg/l
Partition coefficient n-octanol/water (Log Pow)	:	2.35
Partition coefficient n-octanol/water (Log Kow)	:	Not applicable.
Viscosity, kinematic	:	Not applicable.
Viscosity, dynamic	:	Not applicable.
Explosive properties	:	Not applicable.
Oxidizing properties	:	None.
Explosion limits	:	No data available

9.2. Other information

Gas group	:	Press. Gas (Liq.)
Additional information	:	Gas/vapor heavier than air. May accumulate in confined spaces, particularly at or below ground level.

SECTION 10: Stability and reactivity

10.1. Reactivity

No reactivity hazard other than the effects described in sub-sections below.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

May occur.

10.4. Conditions to avoid

High temperature. Catalyst.

10.5. Incompatible materials

Halogens. Oxidizing agents. Acids.

10.6. Hazardous decomposition products

Thermal decomposition may produce : Carbon monoxide. Carbon dioxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Isobutylene (\f)115-11-7	
LC50 Inhalation - Rat	620 mg/l/4h
LC50 Inhalation - Rat [ppm]	541657 ppm/1h
ATE US (gases)	270828.5 ppmV/4h

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Isobutylene (\f)115-11-7	
ATE US (vapors)	620 mg/l/4h
ATE US (dust, mist)	620 mg/l/4h

Skin corrosion/irritation : Not classified

pH: Not applicable.

Serious eye damage/irritation : Not classified

pH: Not applicable.

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Isobutylene (115-11-7)	
National Toxicology Program (NTP) Status	1 - Evidence of Carcinogenicity

Reproductive toxicity : Not classified

STOT-single exposure : Not classified

STOT-repeated exposure : Not classified

Aspiration hazard : Not classified

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : No known ecological damage caused by this product.

12.2. Persistence and degradability

Isobutylene (115-11-7)	
Persistence and degradability	The substance is biodegradable. Unlikely to persist.

12.3. Bioaccumulative potential

Isobutylene (115-11-7)	
Partition coefficient n-octanol/water (Log Pow)	2.35
Partition coefficient n-octanol/water (Log Kow)	Not applicable.
Bioaccumulative potential	Not expected to bioaccumulate due to the low log Kow (log Kow < 4). Refer to section 9.

12.4. Mobility in soil

Isobutylene (115-11-7)	
Mobility in soil	No data available.
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.

12.5. Other adverse effects

Effect on ozone layer : None.

Effect on the global warming : No known effects from this product.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product/Packaging disposal recommendations : Do not attempt to dispose of residual or unused quantities. Return container to supplier.

SECTION 14: Transport information

In accordance with DOT

Transport document description (DOT) : UN1055 Isobutylene, 2.1

UN-No.(DOT) : UN1055

Proper Shipping Name (DOT) : Isobutylene

Class (DOT) : 2.1 - Class 2.1 - Flammable gas 49 CFR 173.115

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Hazard labels (DOT) : 2.1 - Flammable gas



DOT Special Provisions (49 CFR 172.102) : 19 - For domestic transportation only, the identification number UN1075 may be used in place of the identification number specified in column (4) of the 172.101 table. The identification number used must be consistent on package markings, shipping papers and emergency response information.
T50 - When portable tank instruction T50 is referenced in Column (7) of the 172.101 Table, the applicable liquefied compressed gases are authorized to be transported in portable tanks in accordance with the requirements of 173.313 of this subchapter.

Additional information

Emergency Response Guide (ERG) Number : 115 (UN1055)

Other information : No supplementary information available.

Special transport precautions : Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers: - Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.

Transport by sea

UN-No. (IMDG) : 1055

Proper Shipping Name (IMDG) : ISOBUTYLENE

Class (IMDG) : 2 - Gases

Division (IMDG) : 2.1 - Flammable gases

MFAG-No : 115

Air transport

UN-No. (IATA) : 1055

Proper Shipping Name (IATA) : Isobutylene

Class (IATA) : 2 - Gases

Civil Aeronautics Law : Gases under pressure/Gases flammable under pressure

SECTION 15: Regulatory information

15.1. US Federal regulations

Isobutylene (115-11-7)
Listed on the United States TSCA (Toxic Substances Control Act) inventory

All components of this product are listed on the Toxic Substances Control Act (TSCA) inventory.

15.2. International regulations

CANADA

Isobutylene (115-11-7)
Listed on the Canadian DSL (Domestic Substances List)

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EU-Regulations

Isobutylene (115-11-7)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

15.2.2. National regulations

Isobutylene (115-11-7)
Listed introduction on Australian Industrial Chemicals Introduction Scheme (AICIS Inventory) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing New Chemical Substances) inventory Listed on the Japanese ISHL (Industrial Safety and Health Law) Listed on KECL/KECI (Korean Existing Chemicals Inventory) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Listed on INSQ (Mexican National Inventory of Chemical Substances) Listed on the TCSI (Taiwan Chemical Substance Inventory)

15.3. US State regulations

Isobutylene(115-11-7)	
U.S. - California - Proposition 65 - Carcinogens List	No
U.S. - California - Proposition 65 - Developmental Toxicity	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

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SECTION 16: Other information

Other information : When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product.

Linde asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Linde Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Linde Inc, it is the user's obligation to determine the conditions of safe use of the product.

Linde SDSs are furnished on sale or delivery by Linde or the independent distributors and suppliers who package and sell our products. To obtain current SDSs for these products, contact your sales representative, local distributor, or supplier, or download from www.lindeus.com. If you have questions regarding Linde SDSs, would like the document number and date of the latest SDS, or would like the names of the Linde suppliers in your area, phone or write the Linde Call Center (Phone: 1-844-44-Linde (1-844-445-4633); Address: Linde Call Center, Linde Inc, P.O. Box 44, Tonawanda, NY 14151-0044).

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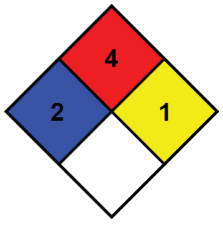
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Revision date : 03/11/2022

NFPA health hazard : 2 - Materials that, under emergency conditions, can cause temporary incapacitation or residual injury.

NFPA fire hazard : 4 - Materials that rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and burn readily.

NFPA instability : 1 - Materials that in themselves are normally stable but can become unstable at elevated temperatures and pressures.



SDS US (GHS HazCom 2012) - Linde 2022

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

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METHANE, COMPRESSED

Safety Data Sheet P-4618

This SDS conforms to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Issue date: 01/01/1978 Revision date: 12/17/2021 Supersedes: 01/29/2021 Version: 1.1

SECTION: 1. Product and company identification

1.1. Product identifier

Product form	:	Substance
Trade name	:	Methane
Chemical name	:	Methane
CAS-No.	:	74-82-8
Formula	:	CH4

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture	:	Industrial use; Use as directed.

1.3. Details of the supplier of the safety data sheet

Linde Inc.
10 Riverview Drive
Danbury, CT 06810-6268, USA
www.lindeus.com

Linde Inc. 1-844-44LINDE (1-844-445-4633)

1.4. Emergency telephone number

Emergency number : Onsite Emergency: 1-800-645-4633

CHEMTREC, 24hr/day 7days/week
— Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887
(collect calls accepted, Contract 17729)

SECTION 2: Hazard identification

2.1. Classification of the substance or mixture

GHS US classification

Flam. Gas 1	H220
Press. Gas (Comp.)	H280
Simple asphyxiant	SIAS

2.2. Label elements

GHS US labeling

Hazard pictograms (GHS US) :



GHS02 GHS04

Signal word (GHS US) : Danger

Hazard statements (GHS US) : H220 - EXTREMELY FLAMMABLE GAS
H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED
OSHA-H01 - MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION.
CGA-HG04 - MAY FORM EXPLOSIVE MIXTURES WITH AIR

Precautionary statements (GHS US) : P202 - Do not handle until all safety precautions have been read and understood.
P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P271+P403 - Use and store only outdoors or in a well-ventilated place.
P377 - LEAKING GAS FIRE: Do not extinguish, unless leak can be stopped safely.
P381 - Eliminate all ignition sources if safe to do so.
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.
P304, P340, P313 - IF INHALED: Remove person to fresh air and keep comfortable for

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breathing. Get medical advice/attention.
CGA-PG05 - Use a back flow preventive device in the piping.
CGA-PG10 - Use only with equipment rated for cylinder pressure.
CGA-PG12 - Do not open valve until connected to equipment prepared for use.
CGA-PG06 - Close valve after each use and when empty.
CGA-PG11 - Never put cylinders into unventilated areas of passenger vehicles.
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F).

2.3. Other hazards

Other hazards which do not result in classification : None.

2.4. Unknown acute toxicity (GHS US)

No data available

SECTION 3: Composition/Information on ingredients

3.1. Substances

Name : METHANE, COMPRESSED

CAS-No. : 74-82-8

Name	Product identifier	%
Methane	(CAS-No.) 74-82-8	100

3.2. Mixtures

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remove to fresh air and keep at rest in a position comfortable for breathing. If not breathing, give artificial respiration. If breathing is difficult, trained personnel should give oxygen. Call a physician.

First-aid measures after skin contact : If skin irritation occurs: Wash with plenty of soap and water.

First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Contact an ophthalmologist immediately.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects, both acute and delayed

No additional information available

4.3. Indication of any immediate medical attention and special treatment needed

None.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Carbon dioxide, Dry chemical, Water spray or fog.

5.2. Special hazards arising from the substance or mixture

Fire hazard : EXTREMELY FLAMMABLE GAS. If venting or leaking gas catches fire, do not extinguish flames. Flammable vapors may spread from leak, creating an explosive reignition hazard. Vapors can be ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharge, or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering an area, especially a confined area, check the atmosphere with an appropriate device.

Explosion hazard : EXTREMELY FLAMMABLE GAS. Forms explosive mixtures with air and oxidizing agents.

Reactivity : No reactivity hazard other than the effects described in sub-sections below.

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5.3. Advice for firefighters

Firefighting instructions : **Danger! FLAMMABLE, HIGH PRESSURE GAS.**

Evacuate all personnel from the danger area. Use self-contained breathing apparatus (SCBA) and protective clothing. Immediately cool containers with water from maximum distance. Stop flow of gas if safe to do so, while continuing cooling water spray. Remove ignition sources if safe to do so. Remove containers from area of fire if safe to do so. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1910 Subpart L—Fire Protection.

Special protective equipment for fire fighters : Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters.

Other information : Containers are equipped with a pressure relief device. (Exceptions may exist where authorized by DOT.).

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : **Danger:** EXTREMELY FLAMMABLE GAS. Forms explosive mixtures with air and oxidizing agents. See section 5. Evacuate personnel to a safe area. Appropriate self-contained breathing apparatus may be required. Approach suspected leak area with caution. Remove all sources of ignition. if safe to do so. Reduce gas with fog or fine water spray. Stop flow of product if safe to do so. Ventilate area or move container to a well-ventilated area. Flammable gas may spread from leak. Before entering the area, especially a confined area, check the atmosphere with an appropriate device.

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

Prevent waste from contaminating the surrounding environment. Prevent soil and water pollution. Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

6.3. Methods and material for containment and cleaning up

No additional information available

6.4. Reference to other sections

See also sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only non-sparking tools. Use only explosion-proof equipment.

Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g, wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

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7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store only where temperature will not exceed 125°F (52°C). Post “No Smoking/No Open Flames” signs in storage and use areas. There must be no sources of ignition. Separate packages and protect against potential fire and/or explosion damage following appropriate codes and requirements (e.g, NFPA 30, NFPA 55, NFPA 70, and/or NFPA 221 in the U.S.) or according to requirements determined by the Authority Having Jurisdiction (AHJ). Always secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand when the container is not in use. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods. For other precautions in using this product, see section 16.

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

7.3. Specific end use(s)

None.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

METHANE, COMPRESSED (74-82-8)	
ACGIH	Not established
USA OSHA	Not established

Methane (74-82-8)	
ACGIH	Not established
USA OSHA	Not established

8.2. Exposure controls

Appropriate engineering controls : Use an explosion-proof local exhaust system with sufficient flow velocity to maintain an adequate supply of air in the worker's breathing zone. Mechanical/General measures: Use in a closed system.

Eye protection : Wear safety glasses when handling cylinders; vapor-proof goggles and a face shield during cylinder changeout or whenever contact with product is possible. Select eye protection in accordance with OSHA 29 CFR 1910.133.

Skin and body protection : Wear metatarsal shoes and work gloves for cylinder handling, and protective clothing where needed. Wear appropriate chemical gloves during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.

Respiratory protection : When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure. For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Gas

Appearance : Colorless gas.

Molecular mass : 16.04 g/mol

Color : Colorless

Odor : odorless

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Odor threshold	:	No data available
pH	:	Not applicable.
Relative evaporation rate (butyl acetate=1)	:	No data available
Relative evaporation rate (ether=1)	:	Not applicable.
Melting point	:	-182 °C
Freezing point	:	No data available
Boiling point	:	-161.5 °C
Flash point	:	No data available
Critical temperature	:	-82.5 °C
Auto-ignition temperature	:	600 °C
Decomposition temperature	:	No data available
Flammability (solid, gas)	:	5 – 15 vol %
Vapor pressure	:	Not applicable.
Critical pressure	:	45.99 bar
Relative vapor density at 20 °C	:	No data available
Relative density	:	0.56
Density	:	0.66 kg/m³ Vapor density @15.6°C, 1 atm
Relative gas density	:	0.7 @15.6°C, 1 atm
Solubility	:	Water: No data available
Partition coefficient n-octanol/water (Log Pow)	:	Not applicable.
Partition coefficient n-octanol/water (Log Kow)	:	Not applicable.
Viscosity, kinematic	:	Not applicable.
Viscosity, dynamic	:	Not applicable.
Explosive properties	:	Not applicable.
Oxidizing properties	:	None.
Explosion limits	:	No data available

9.2. Other information

Gas group	:	Compressed gas
Additional information	:	None.

SECTION 10: Stability and reactivity

10.1. Reactivity

No reactivity hazard other than the effects described in sub-sections below.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

May occur.

10.4. Conditions to avoid

Keep away from heat/sparks/open flames/hot surfaces. – No smoking.

10.5. Incompatible materials

Oxidizing agents. May explode: Bromine pentafluoride. Chlorine. Mercury oxide. Nitrogen trifluoride. Liquid Oxygen. Oxygen difluoride.

10.6. Hazardous decomposition products

Thermal decomposition may produce : Carbon dioxide. Carbon monoxide. Hydrogen.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

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Acute toxicity : Not classified

Skin corrosion/irritation : Not classified

pH: Not applicable.

Serious eye damage/irritation : Not classified

pH: Not applicable.

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

STOT-single exposure : Not classified

STOT-repeated exposure : Not classified

Aspiration hazard : Not classified

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : No known ecological damage caused by this product.

12.2. Persistence and degradability

METHANE, COMPRESSED (74-82-8)	
Persistence and degradability	The substance is biodegradable. Unlikely to persist.

Methane (74-82-8)	
Persistence and degradability	The substance is biodegradable. Unlikely to persist.

12.3. Bioaccumulative potential

METHANE, COMPRESSED (74-82-8)	
Partition coefficient n-octanol/water (Log Pow)	Not applicable.
Partition coefficient n-octanol/water (Log Kow)	Not applicable.
Bioaccumulative potential	No ecological damage caused by this product.

Methane (74-82-8)	
Partition coefficient n-octanol/water (Log Pow)	1.09
Bioaccumulative potential	Not expected to bioaccumulate due to the low log Kow (log Kow < 4). Refer to section 9.

12.4. Mobility in soil

METHANE, COMPRESSED (74-82-8)	
Mobility in soil	No data available.
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.

Methane (74-82-8)	
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.

12.5. Other adverse effects

Effect on ozone layer : None.

Global warming potential [CO2=1] : 21

Effect on the global warming : When discharged in large quantities may contribute to the greenhouse effect.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product/Packaging disposal recommendations : Do not attempt to dispose of residual or unused quantities. Return container to supplier.

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SECTION 14: Transport information

In accordance with DOT

Transport document description (DOT)	:	UN1971 Methane, compressed, 2.1
UN-No.(DOT)	:	UN1971
Proper Shipping Name (DOT)	:	Methane, compressed
Class (DOT)	:	2.1 - Class 2.1 - Flammable gas 49 CFR 173.115
Hazard labels (DOT)	:	2.1 - Flammable gas



Additional information

Emergency Response Guide (ERG) Number	:	115 (UN1971)
Other information	:	No supplementary information available.
Special transport precautions	:	Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers: - Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.

Transport by sea

UN-No. (IMDG)	:	1971
Proper Shipping Name (IMDG)	:	METHANE, COMPRESSED
Class (IMDG)	:	2 - Gases
Division (IMDG)	:	2.1 - Flammable gases
MFAG-No	:	115

Air transport

UN-No. (IATA)	:	1971
Proper Shipping Name (IATA)	:	Methane, compressed
Class (IATA)	:	2 - Gases
Civil Aeronautics Law	:	Gases under pressure/Gases flammable under pressure

SECTION 15: Regulatory information

15.1. US Federal regulations

METHANE, COMPRESSED (74-82-8)
Listed on the United States TSCA (Toxic Substances Control Act) inventory

All components of this product are listed on the Toxic Substances Control Act (TSCA) inventory.

15.2. International regulations

CANADA

METHANE, COMPRESSED (74-82-8)
Listed on the Canadian DSL (Domestic Substances List)

Methane (74-82-8)
Listed on the Canadian DSL (Domestic Substances List)

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Methane (74-82-8)

EU-Regulations

METHANE, COMPRESSED (74-82-8)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

15.2.2. National regulations

METHANE, COMPRESSED (74-82-8)
Listed introduction on Australian Industrial Chemicals Introduction Scheme (AICIS Inventory) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory Listed on KECL/KECI (Korean Existing Chemicals Inventory) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Listed on INSQ (Mexican National Inventory of Chemical Substances) Listed on CICR (Turkish Inventory and Control of Chemicals)

15.3. US State regulations

METHANE, COMPRESSED(74-82-8)	
U.S. - California - Proposition 65 - Carcinogens List	No
U.S. - California - Proposition 65 - Developmental Toxicity	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

Methane (74-82-8)				
U.S. - California - Proposition 65 - Carcinogens List	U.S. - California - Proposition 65 - Developmental Toxicity	U.S. - California - Proposition 65 - Reproductive Toxicity - Female	U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No significant risk level (NSRL)
No	No	No	No	

Methane (74-82-8)
U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

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SECTION 16: Other information

Other information : When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product.

Linde asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Linde Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Linde Inc, it is the user's obligation to determine the conditions of safe use of the product.

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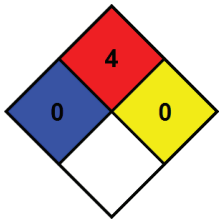
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Revision date : 12/17/2021

NFPA health hazard : 0 - Materials that, under emergency conditions, would offer no hazard beyond that of ordinary combustible materials.

NFPA fire hazard : 4 - Materials that rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and burn readily.

NFPA instability : 0 - Material that in themselves are normally stable, even under fire conditions.



SDS US (GHS HazCom 2012) - Praxair OR Linde

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

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SAFETY DATA SHEET

Version 6.11
Revision Date 03/18/2023
Print Date 04/08/2023

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Methanol

Product Number : 322415
Brand : Sigma-Aldrich
Index-No. : 603-001-00-X
CAS-No. : 67-56-1

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 SPRUCE ST
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable liquids (Category 2), H225
Acute toxicity, Oral (Category 3), H301
Acute toxicity, Inhalation (Category 3), H331
Acute toxicity, Dermal (Category 3), H311
Specific target organ toxicity - single exposure (Category 1), Eyes, Central nervous system, H370

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



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operates as MilliporeSigma in the US and Canada

Signal Word	Danger
Hazard statement(s)	
H225	Highly flammable liquid and vapor.
H301 + H311 + H331	Toxic if swallowed, in contact with skin or if inhaled.
H370	Causes damage to organs (Eyes, Central nervous system).
Precautionary statement(s)	
P210	Keep away from heat/ sparks/ open flames/ hot surfaces. No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P260	Do not breathe mist or vapors.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ eye protection/ face protection.
P301 + P310 + P330	IF SWALLOWED: Immediately call a POISON CENTER/ doctor. Rinse mouth.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340 + P311	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/ doctor.
P307 + P311	IF exposed: Call a POISON CENTER or doctor/ physician.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms	:	Methyl alcohol
Formula	:	CH_4O
Molecular weight	:	32.04 g/mol
CAS-No.	:	67-56-1
EC-No.	:	200-659-6
Index-No.	:	603-001-00-X

Component	Classification	Concentration
Methanol		
	Flam. Liq. 2; Acute Tox. 3; STOT SE 1; H225, H301, H331, H311, H370	<= 100 %

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	Concentration limits: >= 10 %: STOT SE 1, H370; 3 - < 10 %: STOT SE 2, H371;	

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures
No data available

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media
No data available

5.2 Special hazards arising from the substance or mixture
Carbon oxides
Combustible.

5.3 Advice for firefighters
No data available

5.4 Further information
No data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
For personal protection see section 8.

6.2 Environmental precautions
No data available

6.3 Methods and materials for containment and cleaning up
No data available

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling
For precautions see section 2.2.

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7.2 Conditions for safe storage, including any incompatibilities
No data available

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Methanol	67-56-1	TWA	200 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Danger of cutaneous absorption		
		STEL	250 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Danger of cutaneous absorption		
		ST	250 ppm 325 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential for dermal absorption		
		TWA	200 ppm 260 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential for dermal absorption		
		TWA	200 ppm 260 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		PEL	200 ppm 260 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		
		C	1,000 ppm	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		
		STEL	250 ppm 325 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Methanol	67-56-1	Methanol	15 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

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Derived No Effect Level (DNEL)

Application Area	Routes of exposure	Health effect	Value
Workers	Skin contact	Long-term systemic effects	40mg/kg BW/d
Consumers	Skin contact	Long-term systemic effects	8mg/kg BW/d
Consumers	Ingestion	Long-term systemic effects	8mg/kg BW/d
Workers	Skin contact	Acute systemic effects	40mg/kg BW/d
Consumers	Skin contact	Acute systemic effects	8mg/kg BW/d
Consumers	Ingestion	Acute systemic effects	8mg/kg BW/d
Workers	Inhalation	Acute systemic effects	260 mg/m3
Workers	Inhalation	Acute local effects	260 mg/m3
Workers	Inhalation	Long-term systemic effects	260 mg/m3
Workers	Inhalation	Long-term local effects	260 mg/m3
Consumers	Inhalation	Acute systemic effects	50 mg/m3
Consumers	Inhalation	Acute local effects	50 mg/m3
Consumers	Inhalation	Long-term systemic effects	50 mg/m3
Consumers	Inhalation	Long-term local effects	50 mg/m3

Predicted No Effect Concentration (PNEC)

Compartment	Value
Soil	23.5 mg/kg
Sea water	15.4 mg/l
Fresh water	154 mg/l
Fresh water sediment	570.4 mg/kg
Onsite sewage treatment plant	100 mg/kg

8.2 Exposure controls

Personal protective equipment

Skin protection

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Full contact
Material: butyl-rubber
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Butoject® (KCL 898)

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Splash contact
Material: Viton®
Minimum layer thickness: 0.7 mm
Break through time: 120 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

Control of environmental exposure

Prevent product from entering drains.

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SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid Color: colorless
b)	Odor	characteristic
c)	Odor Threshold	10 ppm
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: -98 °C (-144 °F)
f)	Initial boiling point and boiling range	64.7 °C 148.5 °F
g)	Flash point	9.7 °C (49.5 °F) - closed cup - Regulation (EC) No. 440/2008, Annex, A.9
h)	Evaporation rate	6.3 - Diethyl ether1.9 - n-butyl acetate
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 44 %(V) Lower explosion limit: 5.5 %(V)
k)	Vapor pressure	169.27 hPa at 25 °C (77 °F)
l)	Vapor density	1.11
m)	Density	0.791 g/mL at 25 °C (77 °F)
	Relative density	0.79 - 0.820 °C
n)	Water solubility	1,000 g/l at 20 °C (68 °F) - completely miscible
o)	Partition coefficient: n-octanol/water	log Pow: -0.77 at 25 °C (77 °F) - (HSDB), Bioaccumulation is not expected.
p)	Autoignition temperature	455.0 °C (851.0 °F) at 1,013 hPa - DIN 51794
q)	Decomposition temperature	Distillable in an undecomposed state at normal pressure.
r)	Viscosity	0.54 - 0.59 mm2/s at 20 °C (68 °F) -
s)	Explosive properties	No data available
t)	Oxidizing properties	none

9.2 Other safety information

Minimum ignition energy	0.14 mJ
Conductivity	< 1 µS/cm
Relative vapor density	1.11

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SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
No data available

10.3 Possibility of hazardous reactions
Risk of explosion with:
Oxidizing agents
perchloric acid
perchlorates
salts of oxyhalogenic acids
chromium(VI) oxide
halogen oxides
nitrogen oxides
nonmetallic oxides
chromosulfuric acid
chlorates
hydrides
zinc diethyl
halogens
powdered magnesium
hydrogen peroxide
Nitric acid
sulfuric acid
permanganic acid
sodium hypochlorite
Exothermic reaction with:
acid halides
Acid anhydrides
Reducing agents
acids
Bromine
Chlorine
Chloroform
magnesium
tetrachloromethane
Risk of ignition or formation of inflammable gases or vapours with:
Fluorine
Oxides of phosphorus
Raney-nickel
Generates dangerous gases or fumes in contact with:
Alkaline earth metals
Alkali metals

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
No data available

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10.6 Hazardous decomposition products
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
Acute toxicity estimate Oral - 100.1 mg/kg
(Expert judgment)
Remarks: Classified according to Regulation (EU) 1272/2008, Annex VI (Table 3.1/3.2)
Symptoms: Nausea, Vomiting
Acute toxicity estimate Inhalation - 4 h - 3.1 mg/l - vapor

(Expert judgment)
Remarks: Classified according to Regulation (EU) 1272/2008, Annex VI (Table 3.1/3.2)
Symptoms: Irritation symptoms in the respiratory tract.
Acute toxicity estimate Dermal - 300.1 mg/kg
(Expert judgment)
Remarks: Classified according to Regulation (EU) 1272/2008, Annex VI (Table 3.1/3.2)

Skin corrosion/irritation
Skin - Rabbit
Result: No skin irritation
Remarks: (ECHA)
Remarks: Drying-out effect resulting in rough and chapped skin.

Serious eye damage/eye irritation
Eyes - Rabbit
Result: No eye irritation
Remarks: (ECHA)

Respiratory or skin sensitization
Sensitisation test: - Guinea pig
Result: negative
(OECD Test Guideline 406)

Germ cell mutagenicity
Based on available data the classification criteria are not met.
Test Type: Ames test
Test system: Salmonella typhimurium
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 471
Result: negative
Test Type: In vitro mammalian cell gene mutation test
Test system: Chinese hamster lung cells
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 476
Result: negative

Test Type: Micronucleus test
Species: Mouse
Cell type: Bone marrow
Application Route: Intraperitoneal injection
Method: OECD Test Guideline 474
Result: negative

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Carcinogenicity
Did not show carcinogenic effects in animal experiments.

IARC: No ingredient of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No ingredient of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
Based on available data the classification criteria are not met.

Specific target organ toxicity - single exposure
Causes damage to organs. - Eyes, Central nervous system
Remarks: Classified according to Regulation (EU) 1272/2008, Annex VI (Table 3.1/3.2)

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

11.2 Additional Information

RTECS: PC1400000
Acute effects:, Headache, Dizziness, Drowsiness, narcosis, Blindness, Impairment of vision, irritant effects, Nausea, Vomiting, agitation, spasms, inebriation, Coma
Drying-out effect resulting in rough and chapped skin.
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Systemic effects:

acidosis
drop in blood pressure
agitation, spasms
inebriation
Dizziness
Drowsiness
Headache
Impairment of vision
Blindness
narcosis
Coma

Symptoms may be delayed.

Damage to:

Liver
Kidney
Cardiac
Irreversible damage of the optical nerve.

Other dangerous properties can not be excluded.

This substance should be handled with particular care.

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Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	flow-through test LC50 - Lepomis macrochirus (Bluegill) - 15,400.0 mg/l - 96 h (US-EPA)
Toxicity to daphnia and other aquatic invertebrates	semi-static test EC50 - Daphnia magna (Water flea) - 18,260 mg/l - 96 h (OECD Test Guideline 202)
Toxicity to algae	static test ErC50 - Pseudokirchneriella subcapitata (green algae) - ca. 22,000.0 mg/l - 96 h (OECD Test Guideline 201)
Toxicity to bacteria	static test IC50 - activated sludge - > 1,000 mg/l - 3 h (OECD Test Guideline 209)
Toxicity to fish(Chronic toxicity)	NOEC - Oryzias latipes (Orange-red killifish) - 7,900 mg/l - 200 h Remarks: (External MSDS)

12.2 Persistence and degradability

Biodegradability	Result: 99 % - Readily biodegradable. (OECD Test Guideline 301D)
Biochemical Oxygen Demand (BOD)	600 - 1,120 mg/g Remarks: (IUCLID)
Chemical Oxygen Demand (COD)	1,420 mg/g Remarks: (IUCLID)
Theoretical oxygen demand	1,500 mg/g Remarks: (Lit.)
Ratio BOD/ThBOD	76 % Remarks: Closed Bottle test(IUCLID)

12.3 Bioaccumulative potential

Bioaccumulation	Cyprinus carpio (Carp) - 72 d at 20 °C - 5 mg/l(Methanol) Bioconcentration factor (BCF): 1.0

12.4 Mobility in soil

Will not adsorb on soil.

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Endocrine disrupting properties

No data available

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12.7 Other adverse effects

Additional ecological information	Avoid release to the environment.
Stability in water	at 19 °C83 - 91 % - 72 h Remarks: Hydrolyzes on contact with water.Hydrolyzes readily. - 2.2 yr Remarks: reaction with hydroxyl radicals(IUCLID)

SECTION 13: Disposal considerations

13.1 Waste treatment methods

No data available

SECTION 14: Transport information

DOT (US)

UN number: 1230 Class: 3 Packing group: II
Proper shipping name: Methanol
Reportable Quantity (RQ): 5000 lbs
Poison Inhalation Hazard: No

IMDG

UN number: 1230 Class: 3 (6.1) Packing group: II EMS-No: F-E, S-D
Proper shipping name: METHANOL

IATA

UN number: 1230 Class: 3 (6.1) Packing group: II
Proper shipping name: Methanol

SECTION 15: Regulatory information

SARA 302 Components

This material does not contain any components with a section 302 EHS TPQ.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Methanol	67-56-1	2007-07-01

SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Methanol	67-56-1	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Methanol		

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	67-56-1	2007-07-01

California Prop. 65 Components

, which is/are known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.Methanol	CAS-No. 67-56-1	Revision Date 2012-03-16

SECTION 16: Other information

The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

Version: 6.11 Revision Date: 03/18/2023 Print Date: 04/08/2023

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CHESAPEAKE ENERGY

SAFETY DATA SHEET

Natural Gas Condensate **Version: 1.2 Revision Date: 9/24/2019**

SECTION 1: IDENTIFICATION	
(a) PRODUCT IDENTIFIER:	(b) OTHER MEANS OF IDENTIFICATION:
Natural Gas Condensate	Condensate, Gas Well Condensate, Pipeline Liquids

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(c) Recommended Use: Blending stock, diluent

Restrictions On Use: Not to be used for anything other than recommended use.

(d) Producer:

Chesapeake Energy Corporation and Subsidiaries ● 6100 N. Western Avenue, Oklahoma City, OK 73118

Tel: 800-566-9306 ● Fax: 405-753-5468

(e) 24 HR EMERGENCY ASSISTANCE PHONE NUMBER: **Verisk 3E – 800-451-8346/Client ID 11906**

SECTION 2: HAZARDS IDENTIFICATION

The categories of Health Hazards as defined in OSHA 29 CFR 1910.1200 Hazard Communication Standard have been evaluated and are listed below. Refer to Sections 3, 8, and 11 for additional information.

Hazard Classification	(a) Hazard Category	(b) Hazard Symbols	(b) Signal Word	(b) Hazard Statement	(b) Precautionary Statements
Human Health Hazards					
Acute Toxicity (Oral)	N/C	-	-	-	-
Acute Toxicity (Dermal)	N/C	-	-	-	-
Acute Toxicity (Inhalation)	N/C	-	-	-	-
Skin Corrosion/ Irritation	2		Warning	Causes skin irritation	Wear protective gloves P264, P280, P302/P352, P332/P313, P362/P364
Eye Damage/ Irritation	2A		Warning	Causes serious eye irritation	Wear eye protection P264, P280, P305, P351, P338, P337, P313
Respiratory Sensitization	N/D	-	-	-	-
Skin Sensitization	N/C	-	-	-	-
Germ Cell Mutagenicity	1B		Danger	May cause genetic defects	Wear protective clothing P201, P202, P280, P308, P313, P405, P501
Carcinogenicity	1A		Danger	May cause cancer	Do not handle until all safety precautions have been read and understood P201, P202, P280, P308, P313, P405, P501
Reproductive Toxicity	N/D	-	-	-	-

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CHESAPEAKE ENERGY

SAFETY DATA SHEET

SECTION 2: HAZARDS IDENTIFICATION

The categories of Health Hazards as defined in OSHA 29 CFR 1910.1200 Hazard Communication Standard have been evaluated and are listed below. Refer to Sections 3, 8, and 11 for additional information.

Hazard Classification	(a) Hazard Category	(b) Hazard Symbols	(b) Signal Word	(b) Hazard Statement	(b) Precautionary Statements
Human Health Hazards					
Specific Target Organ Toxicity (STOT) Single-Exposure	3		Warning	May cause drowsiness or dizziness	Avoid breathing vapors P261, P271, P304, P340, P312, P403, P405, P233, P501
Specific Target Organ Toxicity (STOT) Repeated or Prolonged Exposure	2		Warning	May cause damage to liver, kidneys, blood, nervous system, spleen, thymus, and skin through prolonged or repeated exposure.	Get medical advice/attention if you feel unwell P260, P314, P501
Aspiration Hazard	1		Danger	May be fatal if swallowed and enters airways	If swallowed: Immediately call a poison center P301, P310, P405, P501
Simple Asphyxiant	-	-	Warning	May displace oxygen and cause rapid suffocation	-

Health Hazard Precautionary Statement	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P233	Keep container tightly closed.
P260	Do not breathe dust/fume/gas/mist/vapors/spray.
P261	Avoid breathing dust/fume/gas/mist/vapors/spray.
P264	Wash thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ protective clothing/eye protection/face protection.
P301+P310	If swallowed: Immediately call a poison center or doctor.
P304 + P340	If inhaled: Remove person to fresh air and keep comfortable for breathing.
P305	If in eyes: Rinse cautiously with water for several minutes.
P351	Remove contact lenses.
P338	Continue rinsing.
P337+ P313	If eye irritation persists. Get medical advice/attention.
P308 + P312	If exposed or concerned. Call a poison center or doctor if you feel unwell.
P314	Get medical advice/attention if you feel unwell.
P403	Store in a well-ventilated place.
P405	Store locked up.
P501	Dispose of contents/container to an approved facility.

Hazard Classification	Hazard Category	Hazard Symbols	Signal Word	Hazard Statement	Precautionary Statement
Physical Hazards					
Explosives	N/C	-	-	-	-

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Hazard Classification	Hazard Category	Hazard Symbols	Signal Word	Hazard Statement	Precautionary Statement
Physical Hazards					
Flammable Gases	N/C	-	-	-	-
Flammable Aerosols	N/C	-	-	-	-
Oxidizing Gases	N/C	-	-	-	-
Gases Under Pressure	N/C	-	-	-	-
Flammable Liquids	1		Danger	Extremely flammable liquid and vapor	Keep away from heat/sparks/open flames/hot surfaces. No Smoking. P210, P233, P240, P241, P242, P243, P280, P303, P361, P353, P370, P378, P403, P235, P501
Flammable Solids	N/C	-	-	-	-
Self-reactive Substances and Mixtures	N/C	-	-	-	-
Substances and mixtures which react with water to emit flammable gases	N/C	-	-	-	-
Oxidizing Liquids	N/C	-	-	-	-
Oxidizing Solids	N/C	-	-	-	-
Organic Peroxides	N/C	-	-	-	-
Corrosive to Metals	N/C	-	-	-	-

Physical Hazard Precautionary Statement	
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233	Keep container tightly closed.
P235	Keep cool.
P240	Ground/Bond container and receiving equipment.
P241	Use explosion-proof electrical/ventilating/lighting/equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P264	Wash all body parts in contact with material thoroughly after handling.
P280	Wear protective gloves/eye protection/face protection.
P303+P352+P353	If on skin or hair: Wash with plenty of water. Rinse skin with water/shower.
P361	Remove/take off immediately all contaminated clothing.
P362+P364	Take off contaminated clothing. Wash before reuse.
P332+P313	If skin irritation occurs: Get medical advice/attention.
P370+P378	In case of fire. Use dry chemical, carbon dioxide, or foam to extinguish.
P403	Store in a well-ventilated place.
P501	Dispose of contents/container to an approved disposal facility.

Hazard Classification	(a) Hazard Category	(b) Hazard Symbols	(b) Signal Word	(b) Hazard State-ment	(b) Precautionary Statement
Environmental Hazards					
Acute Toxicity to the Aquatic Environment	2	-	-	Toxic to aquatic life	-
Chronic Toxicity to the Aquatic Environment	2		-	Toxic to aquatic life with long last-ing effects	-

(c) Hazards not otherwise classified: Exposure to aliphatic hydrocarbons can sensitize the myocardium to epinephrine-induced car-diac arrhythmias.

(d) Unknown acute toxicity: approximately 30% of this mixture consists of ingredients of unknown acute toxicity.

(e) Medical conditions which are generally recognized as being aggravated by exposure: Individuals with pre-existing central nerv-ous system disease, chronic respiratory diseases, skin or eye disorders, or impaired liver or kidney function may be at increased risk from exposure.

*SECTION 3: COMPOSITION / INFORMATION ON INGREDIENTS**

Hydrocarbon Ranges	(a) Chemical name (b) (Common name and synonyms)	(c) CAS No.	(c) EC No.	(b) % Weight
	Natural Gas Condensate	64741-47-5	265-047-3	100
	Components			
Aliphatic				
$C_1 – C_3$	Asphyxiant gases (methane, ethane, propane)	-	-	0 - 1
C_4	Butane (all isomers)	68513-65-5	271-009-7	20 - 30
C_5	Pentanes	-	-	35 - 45
$C_6 – C_8$	“Light aliphatic” ($C_7 – C_9$ aliphatic solvents; heptane)	-	-	18 - 25
	n-Hexane	110-54-3	203-777-6	7 - 10
$C_9 – C_{18}$	“Mid-range aliphatic” ($C_{>8}$-C_{16} aliphatic hydrocarbons)	-	-	0 - 2
$C_{19} – C_{32}$	“Heavy aliphatic” ($C_{19} – C_{32}$ Aliphatic hydrocarbons)	-	-	< 1
Aromatic				
C_6	Benzene	71-43-2	200-753-7	0 - 2
$C_7 – C_8$	Ethylbenzene	100-41-4	202-849-4	0 - 1
	Toluene	108-88-3	203-625-9	0 - 2
$C_9 – C_{16}$	“Mid-range aromatic” ($C_{>8}$-C_{16} aromatic hydrocarbons)	-	-	0 - 2
$C_{17} – C_{32}$	“Heavy aromatic” (C_{17}-C_{32} aromatic hydrocarbons)	-	-	< 1
	Hydrogen sulfide	7783-06-4	231-977-3	< 0.5 highly var-iable

*Natural gas condensate is a complex combination of hydrocarbons separated as a liquid from natural gas in a surface separator by retrograde condensation. It consists mainly of hydrocarbons having carbon numbers predominantly in the range of C_2 to C_{20}. It is a liquid at atmospheric temperature and pressure. The concentration ranges listed above are based on specific testing results and reported industry values. Components of this product are normally within the ranges listed above; however, depending on the geo-graphical source, condensate composition may vary.

SECTION 4: FIRST AID MEASURES

(a) Description of necessary measures:

Emergency Medical advice is available from regional poison control centers 1-800-222-1222.

INHALATION:	Move to fresh air immediately. If breathing stops, provide artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
INGESTION:	Rinse mouth. There is a potential for aspiration if swallowed. Do not induce vomiting. If vomiting occurs, place on left side and keep head low . Seek medical help immediately.
SKIN CONTACT:	If on skin: Wash with plenty of mild soap and water. If skin irritation occurs: Get medical advice/attention. Remove contaminated clothing immediately and wash it before reuse.
EYE CONTACT:	Flush eyes immediately with water for 15 minutes while holding eyelids open. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

(b) Most important symptoms/effects:

- **Acute:** Headache, drowsiness, loss of mental alertness and coordination, dizziness, nausea.
- **Delayed:** Dry skin and possible irritation with repeated or prolonged exposure.

(c) Indication of immediate medical attention and special treatment: Significant over-exposure

Notes to physician: Treat symptomatically and supportively. This material may contain or release hydrogen sulfide. In high doses, hydrogen sulfide may produce pulmonary edema and respiratory depression or paralysis. Exposure to hydrocarbon can sensitize the myocardium to epinephrine-induced cardiac arrhythmias. If epinephrine or other sympathomimetic drugs are administered, observe for the development of cardiac arrhythmias.

General advice: In the case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Show this safety data sheet to the doctor in attendance. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

SECTION 5: FIRE FIGHTING MEASURES

(a) Suitable extinguishing media: Foam, Dry chemical, carbon dioxide, water spray can cool the fire but may not extinguish the fire.
Unsuitable extinguishing media: High volume water jet. It will spread the fire.

(b) Specific hazards arising from the chemical: Condensate is an extremely flammable liquid and vapor. It can be ignited by heat, spark, flames, or other sources of ignition (e.g., static electricity, pilot lights, mechanical/electrical equipment, and electronic devices such as cell phones, computers, and pagers which have not been certified as intrinsically safe). Vapors can travel considerable distances to spaces, outdoors, or in sewers. This product will float and can be reignited on surface water. Vapors can be heavier than air and can accumulate in low-lying areas. If container is not properly cooled, it can rupture in the heat of a fire. Hazardous combustion/decomposition products may be released by this material when exposed to heat or fire. Use caution and wear appropriate PPE, including respiratory protection.

(c) Special protective equipment and precautions for fire-fighters: Shut off flow immediately if it can be done safely. Isolate the area from personnel. Keep personnel upwind from fire. Fire fighters should use appropriate SCBA while in close proximity to fire and vapors coming from product. Move personnel upwind of any smoke or vapors. In the event of fire and/or explosion, do not breathe fumes.

(d) Flammability/Explosivity: NFPA RATING Hazard Class:
Health = 1 (=3 if Hydrogen Sulfide is present)
Fire = 4
Instability = 0
(0-Minimal, 1-Slight, 2-Moderate, 3-Serious, 4-Severe)

(e) Hazardous Decomposition Products: Normal combustion forms carbon dioxide and water vapor; incomplete combustion may produce carbon monoxide.

SECTION 6: ACCIDENTAL RELEASE MEASURES

(a) Personal precautions, Protective equipment, and Emergency procedures: Condensate is extremely flammable. Stay upwind if possible. Eliminate all ignition sources. Avoid inhalation of vapors and spray mist. Avoid contact with skin and eyes. Wear appropriate PPE including respiratory protection as needed. On hard surfaces, spilled condensate may create a slipping hazard.

Federal regulations (29 CFR 1910.1028) specify medical surveillance programs for certain exposures to benzene. Additionally, in an emergency situation, exposed employees may need to provide a urine sample at the end of shift for urine phenol.

(b) Methods and materials for containment and cleaning up: Remove sources of ignition. Beware of explosion danger. Stop flow of product, if it is safe to do so. Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended if possible. Dike the spilled material. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water, remove with appropriate methods (e.g., skimming, booms, or absorbent boom). In the case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations. Recommended measures are based on the most likely spill scenarios for this material; however, local conditions and regulations may influence or limit the choice of appropriate actions to be taken.

Environmental Precautions: Prevent product from entering drains and sanitary sewers. Prevent further leakage or spillage if safe to do so. If product impacts rivers, lakes, drains, or any other body of water, contact appropriate authorities. Consult with an environmental professional for the federal, state, and local cleanup and reporting requirements.

SECTION 7: HANDLING AND STORAGE

(a) Precautions for safe handling: Keep away from ignition sources such as heat/sparks/open flame. Take precautionary measures against static discharge. Non-sparking tools should be used. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not eat, drink, or smoke when using this product. Do not breathe vapors or mists. Use only outdoors or in well-ventilated area. Wear protective gloves/clothing and eye/face protection. Wash thoroughly after handling. Use good personal hygiene practices. Wear appropriate personal protective equipment including flame resistant clothing. Avoid vapors when opening tank hatches and dome covers.

Condensate is extremely flammable. It may vaporize easily at ambient temperatures. The vapor may be heavier than air and may create an explosive mixture of vapor and air. Beware of accumulation in confined spaces and low-lying areas. Open container slowly to relieve any pressure. Electrostatic charge may accumulate and create a hazardous condition when handling or processing this material. To avoid fire or explosion, dissipate static-electricity during transfer by grounding and bonding containers and equipment before transferring material. The use of explosion-proof electrical equipment is recommended and may be required (see appropriate fire codes). Refer to NFPA-70 and/or API RP 2003 for specific bonding/grounding requirements. Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. Do not wear contaminated clothing or shoes. Keep contaminated clothing away from sources of ignition such as sparks or open flames.

Static Accumulation Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding of tanks, transfer piping, and storage tank level floats are necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating and accumulating an electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures. Special care should be given to ensure that slow load procedures for “switch loading” are followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil or diesel) is loaded into tanks previously containing low flash point products. For more information, refer to OSHA Standard 29 CFR 1910.106 ‘Flammable and Combustible Liquids’, National Fire Protection Association (NFPA 77, ‘Recommended Practice on Static Electricity’, and/or the American Petroleum Institute (API) Recommended Practice 2003, ‘Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents’.

(b) Conditions for safe storage, including any incompatibilities: May be incompatible with strong oxidizing agents such as nitric acid, peroxides, and perchlorates. Potentially Incompatible Absorbents: None identified.

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Limits			
Components	**(a) OSHA PEL[1]**	**(a) ACGIH TLV[2]**	**(a) IDLH[3]**
Propane	1,000 ppm (TWA)	NE	2,100 ppm
Butane (all isomers)	NE	1,000 ppm (C)	NE
Pentane (all isomers)	1,000 ppm (TWA)	1,000 ppm (TWA)	1,500 ppm
"Light aliphatic" hydrocarbons	NE	NE	NE
n-Hexane	500 ppm (TWA)	50 ppm (TWA) Skin	1,100 ppm
"Mid-range aliphatic" hydrocarbons	NE	NE	NE
Benzene	1 ppm (TWA) 5 ppm (STEL)	0.5 ppm (TWA) 2.5 ppm (STEL) Skin	500 ppm
Ethylbenzene	100 ppm (TWA)	20 ppm (TWA)	800 ppm
Toluene	200 ppm (TWA) 300 ppm (C)	20 ppm (TWA)	500 ppm
"Mid-range aromatic" hydrocarbons	NE	NE	NE
Hydrogen sulfide	20 ppm (C)	1 ppm (TWA) 5 ppm (STEL)	100 ppm

Notes:

1. OSHA PEL are 8-hour TWA (Time-weighted average) concentrations unless otherwise noted. A ("C") designation denotes a ceiling limit, which should not be exceeded during any part of the working exposure unless otherwise noted. A Short Term Exposure Limit (STEL) is defined as a 15-minute exposure, which should not be exceeded at any time during a workday.
2. Threshold Limit Values – TWA established by the ACGIH represents the TWA concentration for a conventional 8-hour work-day and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed , day after day, for a working lifetime without adverse effect; Short-Term Exposure Limit (TLV-STEL) represents a 15-minute TWA exposure that should not be exceeded at any time during a work day. ACGIH TLV's are for guideline purposes only and as such are not legal, regulatory limits for compliance purposes (ACGIH, 2014).
3. The "immediately dangerous to life or health air concentration values (IDLHs)" are used by NIOSH as part of a respiratory selection criteria.
4. No exposure limits have been developed by the producer.

(b) Appropriate engineering controls: Provide adequate general and local ventilation to maintain airborne chemical concentrations below applicable exposure limits, to prevent accumulation of flammable vapors and formation of explosive atmosphere, and to prevent formation of an oxygen deficient environment. Use non-sparking explosion proof, totally enclosed ventilation systems. Only use non-sparking tools, if engineering controls or work activities are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

Eye/face protection: Wear approved safety glasses/goggles with side shields and/or an appropriate full-face shield. All eye protection should be selected and worn in accordance with the OSHA eye and face protection guidelines outlined in 29 CFR 1910.132 and 1910.133-ANZI Z87.1; and/or CSA Standard CAN/CSA-Z94.3-92.

Skin Protection: Wear appropriate clothing to prevent skin contact. Thoroughly decontaminate any articles of clothing that come into contact with product. The use of gloves is advised to prevent skin exposure and contact. Users should check with manufacturers to confirm the breakthrough performance of their products. Depending on exposure and conditions, additional protection may be necessary to prevent skin contact including items such as chemical resistant boots, aprons, arm covers, hoods, coveralls, or encapsulated suits. All PPE should be selected and worn in accordance with 29 CFR 1910.132 and 1910.138. Flame resistant clothing that meets the NFPA 2112 and CAN/CGSB 155.20 standards is recommended in areas where material is stored or handled.

Respiratory protection: A positive pressure air line with full-face mask and escape bottle or a self-contained breathing apparatus (SCBA) should be available in case of an emergency and cases when the IDLH is exceeded. All respirators should be selected and worn in accordance with 29 CFR 1910.132 and 1910.134, and/or CSA Standard CAN/CSA-Z94.4-11.
General hygiene considerations: Always observe good personal hygiene measures, such as washing after handling the material, and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Eyewash and quick-drench shower facilities should be available in the work area.
General: Wear chemical protective equipment. Launder contaminated clothing before reuse.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

	Physical and Chemical Properties
	Solution:
(a) Appearance:	A colorless to straw-yellow liquid
(b) Odor:	Petroleum
(c) Odor Threshold:	N/A
(d) pH:	N/A
(e) Melting point/Freezing point:	N/A
(f) Initial Boiling point:	85 to 437 °F / 39 to 200 °C
(g) Flash Point:	AP -40 °F / <-40 °C
(h) Evaporation rate:	High
(i) Flammability:	N/A
(j) UFL/LFL or UEL/LEL:	N/A
(k) Vapor pressure:	~110 psia @ 100°F
(l) Vapor density:	> 1
(m) Relative density:	NA
(n) Solubility:	Negligible
(o) Partition coefficient:	N/A
(p) Auto-ignition temperature:	450 °F / 232 °C
(q) Decomposition temperature:	N/A
(r) Viscosity:	N/A
(s) Specific Gravity:	AP 0.62 – 0.76

SECTION 10: STABILITY AND REACTIVITY

(a) Reactivity: Saturated aliphatic hydrocarbons, the major components of condensate, are incompatible with strong oxidizing agents such as nitric acid. Charring may occur followed by ignition of the material and nearby combustibles. In other settings, mostly unreactive. Not affected by aqueous solutions of acids, alkalis, most oxidizing agents, and most reducing agents. When heated sufficiently or when ignited in the presence of air oxygen, will burn exothermically to produce carbon dioxide and water.

(b) Chemical stability: Material is stable under normal conditions.

(c) Possibility of hazardous reactions: Hazardous polymerization will not occur.

(d) Conditions to avoid (e.g., static discharge, shock, or vibration): Excess heat, open flames, sparks, static discharge, smoking, ignition sources, and incompatible materials.

(e) Incompatible materials: Strong oxidizing agents, strong acids and alkalis.

(f) Hazardous decomposition products: carbon dioxide, carbon monoxide, smoke (non-combusted hydrocarbons). Oxides of nitrogen may also be formed.
(g) Hazardous Polymerization: Will not occur.

SECTION 11: TOXICOLOGICAL INFORMATION

(a) Information on likely routes of exposure:

- **Inhalation:** causes irritation of upper respiratory tract; central nervous system stimulation followed by depression of varying degrees ranging from dizziness, headache, and incoordination to anesthesia, coma, and respiratory arrest; irregular heartbeat is dangerous complication.
- **Accidental Ingestion:** causes irritation of mucous membranes of throat, esophagus, and stomach; stimulation followed by depression of central nervous system; irregular heartbeat.
- **Skin contact:** May cause skin irritation with prolonged or repeated contact.
- **Eye contact:** May cause moderate irritation.

(b) Symptoms related to physical, chemical and toxicological characteristics: Skin contact may cause dermal irritation. Excessive inhalational exposures may cause irritation to nose, throat, lungs, and respiratory tract. Central nervous system effects may include headache, dizziness, loss or balance and coordination, unconsciousness, and respiratory failure.

(c) Delayed and immediate effects and also chronic effects from short- and long-term exposure: Chronic skin exposures can lead to dermatitis. Laboratory animal studies of petroleum products by the dermal and inhalation exposure routes through prolonged or repeated exposure have demonstrated toxicity to the liver, blood, spleen and thymus.

(d) Numerical measures of toxicity:

Acute Toxicity (Oral)			
Chemical	Tested % Weight	Model	LD_{50} Range (mg/kg bw)
$C_1 – C_3$	No data available		
n-Butane	No data available		
Pentanes	100	Rat	> 2,000 mg/kg
n-Hexane	100	Mouse	5,000 mg/kg
C_6-C_8 Aliphatic Hydrocarbons (minus n-hexane)	100	Rat	>5,000 - > 15,000 mg/kg
$C_{>8}$-C_{16} Aliphatic Hydrocarbons	100	Mouse	>5,000 – 15,800 mg/kg
$C_{19} – C_{32}$ Aliphatic Hydrocarbons	100	Rat	> 5,000 mg/kg
	100	Rat	3,306 mg/kg
Ethylbenzene	100	Rat	3,500 – 5,460 mg/kg
Toluene	100	Rat	1,640 – 7,500 mg/kg
$C_9 – C_{16}$ Aromatic Hydrocarbons	No data available		
$C_{17} – C_{32}$ Aromatic Hydrocarbons	100	Rat	2,700 mg/kg
Hydrogen sulfide	70	Rat	100 – 215 mg/kg

Acute Toxicity (Dermal)			
Chemical	% Weight	Model	LD_{50} Range (mg/kg bw)
$C_1 – C_3$	No data available		
Butane	No data available		
Pentanes	100	Rabbit	3,000 mg/kg

Acute Toxicity (Dermal)			
Chemical	% Weight	Model	LD_{50} Range (mg/kg bw)
n-Hexane	100	Rabbit	3,000 mg/kg
C_6-C_8 Aliphatic Hydrocarbons (minus n-hexane)	100	Rabbit	> 2,920 - > 3,160 mg/kg
$C_{>8}$-C_{16} Aliphatic Hydrocarbons	100	Rabbits & rats	> 2,000 mg/kg
C_{19} – C_{32} Aliphatic Hydrocarbons	100	Rat	> 2,000 mg/kg
Benzene	100	Rabbit	8,260 mg/kg
Ethylbenzene	100	Rabbit	17,800 mg/kg
Toluene	100	Rabbit	12,124 mg/kg
C_9 – C_{16} Aromatic Hydrocarbons	No data available		
C_{17} – C_{32} Aromatic Hydrocarbons	Data not sufficient for classification		
Hydrogen sulfide	No data available		

Acute Toxicity (Inhalation)		
Chemical	Model	LC_{50} Range (mg/L)
C_1 – C_3	Rat	>1,464 mg/L/15 min
n-Butane	Rat	658 mg/L
Pentanes	Rat	> 18 mg/L
n-Hexane	Rat	169 mg/L
C_6-C_8 Aliphatic Hydrocarbons (minus n-hexane)	Rat	> 23 to > 33 mg/L
$C_{>8}$-C_{16} Aliphatic Hydrocarbons	Rat	24 mg/L
C_{19} – C_{32} Aliphatic Hydrocarbons	Rat	> 5,000 mg/L
Benzene	Rat	31.9 mg/L
Ethylbenzene	No data available	
Toluene	Rat	>20 mg/L
C_9 – C_{16} Aromatic Hydrocarbons	No data available	
C_{17} – C_{32} Aromatic Hydrocarbons	Data not sufficient for classification	
Hydrogen sulfide	Rat	380 – 1,500 mg/m^3

Skin corrosion and/or irritation: Prolonged skin contact may cause mild to moderate irritation; repeated contact may cause defatting of the skin

Serious eye damage and/or eye irritation: Direct contact with the eyes may cause mild to moderate eye irritation; transient injury to the conjunctiva, including redness, may occur.

Respiratory sensitization: No data available.

Skin sensitization: No evidence of skin sensitization

Germ cell mutagenicity: Generally negative; some components (benzene) may cause chromosomal aberrations.

Reproductive toxicity: Mostly negative findings; some components (C_1 – C_3) NOAEC for reproductive effects 10,000 ppm

Specific target organ toxicity (single exposure): Not classified; some evidence of CNS effects, e.g. drowsiness and dizziness, by some components (C_5 and greater). Some evidence of sudden cardiac effects for short-chain aliphatic hydrocarbons.

Specific target organ toxicity (repeated exposure): May cause effects on CNS (including hearing), hematological system, liver and kidney through prolonged or repeated exposure.

Aspiration hazard: May cause pneumonitis upon swallowing due to aspiration into the lung. May be fatal.

(e) Carcinogenicity:

Carcinogenicity				
Compound	ACGIH	IARC	NTP	OSHA
$C_1 – C_3$	Not classified	Not classified	Not listed	Not classified
Butane	Not classified	Not classified	Not listed	Not classified
Pentanes	Not classified	Not classified	Not listed	Not classified
n-Hexane	Not classified	Not classified	Not listed	Not classified
C_6-C_8 Aliphatic Hydrocarbons (minus n-hexane)	Not classified	Not classified	Not listed	Not classified
$C_{>8}$-C_{16} Aliphatic Hydrocarbons	Not classified	Not classified	Not listed	Not classified
$C_{19} – C_{32}$ Aliphatic Hydrocarbons	Not classified	Not classified	Not listed	Not classified
Benzene	A1 – Confirmed Human Carcinogen	Group 1 – Carcinogenic to Humans	Known to be a human carcinogen	Carcinogen
Ethylbenzene	A3 - Confirmed animal carcinogen with unknown relevance to humans.	Group 2B - Possibly carcinogenic to humans	Not listed	Not classified
Toluene	A4 - Not classifiable as a human carcinogen.	Group 3 – Not classifiable as to its carcinogenicity to humans	Not listed	Not classified
$C_9 – C_{16}$ Aromatic Hydrocarbons	Not classified	Not classified	Not listed	Not classified
$C_{17} – C_{32}$ Aromatic Hydrocarbons	Not classified	Not classified	Not listed	Not classified

SECTION 12: ECOLOGICAL INFORMATION

(a) Ecotoxicity: This material is expected to be potentially toxic to aquatic organisms. Ecotoxicity data have not been determined specifically for this mixture. A range of measurements of aquatic toxicity has been obtained in laboratory studies of hydrocarbon mixtures with LC_{50} or EC_{50} values in the range of 1 to 100 mg/L. The values are generally consistent with the predicted aquatic toxicity of this mixture based on the hydrocarbon composition. Acute toxicity could potentially fall within the range of 1 – 10 mg/L, depending on the proportion of low molecular weight hydrocarbons in the mixtures composition (EPA, 2011).

(b) Persistence and degradability: Hydrocarbon mixtures are not considered readily biodegradable and most nonvolatile components are not biodegradable. Some components are persistent in water. Lighter components will tend to evaporate but the heavier components may become dispersed in water or absorbed to soil or sediment.

(c) Bioaccumulative potential: The octanol water coefficient (Log K_{ow}) values for the hydrocarbon components of this material range from less than 2 to greater than 6, and therefore would be regarded as having the potential to bioaccumulate.

(d) Mobility in soil: Some components may be mobile and contaminate groundwater.

(e) Other adverse effects: Coating with this mixture can kill birds, plankton, aquatic life, algae, and fish.

SECTION 13: DISPOSAL CONSIDERATIONS

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CHESAPEAKE ENERGY

SAFETY DATA SHEET

WASTE DISPOSAL: It is the responsibility of the user to determine if disposal material is hazardous according to federal, state and local regulations. Dispose of waste in accordance with the federal, state, and local laws and regulations. This material may be considered a RCRA hazardous waste under 40 CFR 261-271 due to its ignitability. The product can be an ignitable hazardous waste. It is recommended that this product, in any form, be incinerated in suitable combustion chamber for disposal. If possible, use a flare.

Containers should be completely used and emptied prior to discarding. Residues from containers can possibly be considered to be hazardous wastes.

EPA Waste Number:
D001-Ignitability Characteristic
D018-Toxicity Characteristic (Benzene)

SECTION 14: TRANSPORT INFORMATION

U.S. Department of Transportation (DOT)

SHIPPING NAME:	Hydrocarbons, liquid, n.o.s. (contains natural gas condensate)	IATA HAZARD CLASS:	3
DOT HAZARD CLASS:	3	IMDG CLASS:	3
DOT SHIPPING ID:	UN3295	RID/ADR CODES:	
*PACKING GROUP:	I, II	*PACKING GROUP:	I, II
LABEL:	Flammable Liquid/3295	HAZARD ID:	Flammable liquid

Emergency Response Guide: 128

Canada Transportation of Dangerous Goods (TDG)
Proper Shipping Name: UN3295, Hydrocarbons, liquid, n.o.s (contains natural gas condensate), 3, PG 1, II
Class: 3 UN Number: UN3295 Packing Group: I, II

SECTION 15: REGULATORY INFORMATION

This product is a “Hazardous Chemical” as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200

CERCLA/SARA-Section 311/312 (Title III Hazard Categories)

Acute Health	Yes
Chronic Health	Yes
Fire Hazard	Yes
Pressure Hazard	No
Reactive Hazard	No

US EPCRA (SARA Title III) Section 313-Toxic Chemical: De minimis concentration

Component	De minimis
Benzene	0.1%
Toluene	1.0%
Ethylbenzene	0.1%
n-Hexane	1.0%

CERCLA (Superfund) reportable quantity (lbs.)
EPA's Petroleum Exclusion applies to this material - (CERCLA 101(14))

California Proposition 65: Warning: This material may contain detectable quantities of the following chemicals, known to the State of California to cause cancer, birth defects or other reproductive harm, and which may be subject to the requirements of California Proposition 65 (CA Health & Safety Code Section 25249.5): ethyl benzene, benzene, toluene.

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SAFETY DATA SHEET

Component Analysis - State

Component	CAS	CA	MA	MN	NJ	PA	RI
Benzene	71-43-2	Yes	Yes	Yes	Yes	Yes	Yes
Toluene	108-88-3	Yes	Yes	Yes	Yes	Yes	Yes
Ethylbenzene	100-41-4	Yes	Yes	Yes	Yes	Yes	Yes
n-Hexane	110-54-3	Yes	Yes	Yes	Yes	Yes	Yes

National Chemical Inventories:
All components are either listed on the US TSCA Inventory, or are not regulated under TSCA.
All components are either on the DSL, or are exempt from DSL listing requirements.

U.S. Export Control Classification Number: EAR99

EPA CWA &OPA

This product is classified as an 'oil' under Section 311 of the Clean Water Act (CWA) and Oil Pollution Act of 1990 (OPA), subject to spill reporting requirements.

Canada (DSL)
The components of this product are in compliance with the chemical notification requirements of the NSN Regulations under CEPA, 1999.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.

Workplace Hazardous Materials Information System (WHMIS) Hazard Class

B2 - Flammable Liquid
D1A - Material Causing Immediate and Serious Toxic Effects --- Very Toxic Material
D2A - Material Causing Other Toxic Effects --- Very Toxic
D2B - Material Causing Other Toxic Effects --- Toxic Material

Hazard Symbols:



Component Analysis - WHMIS IDL

The following component is identified under the Canadian Hazardous Products Act Ingredient Disclosure List:

Component	CAS #	Minimum Concentration
Benzene	71-43-2	0.1 %
Toluene	108-88-3	1 %
Ethylbenzene	100-41-4	0.1 %

SECTION 16: OTHER INFORMATION

This Safety Data Sheet is authored pursuant to the OSHA Hazard Communication/HazCom 2012 Final Rule.

COMMON TERMS AND ACRONYMS:

ACGIH: American Conference of Governmental Industrial Hygienists
C: Ceiling Limit
CAS#: Chemical Abstracts System Number
CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act
CNS: Central Nervous System

DOT: Department of Transportation
DSL: Domestic Substance List
EC_{50}: Effective concentration that inhibits the endpoint to 50% of control population
EINECS: European List of Notified Chemical Substances
EPA: U.S. Environmental Protection Agency
ESIS: European Chemical Substances Information System
HMIS: Hazardous Materials Identification System
IARC: International Agency for Research on Cancer
IDLH: Immediately Dangerous to Life and Health
IATA: International Air Transport Association
IMDG: International Maritime Dangerous Goods
LC_{50}: Concentration of air resulting in death to 50% of experimental animals
LD_{50}: Administered dose resulting in death to 50% of experimental animals
LEL: Lower Explosive Limit
MSHA: Mine Safety and Health Administration
NFPA: National Fire Protection Association
NIOSH: National Institute for Occupational Safety and Health
N/A: Not Available
N/C: Not Classified
N/D: No applicable data available
NE: Not Established
NOAEC: No Observed Adverse Effect Concentration
NTP: National Toxicology Program
OECD: Organization for Economic Co-operation and Development
OSHA: Occupational Safety and Health Administration
PEL: Permissible Exposure Limit
PPE : Personal Protective Equipment
RCRA: Resource Conservation and Recovery Act
SARA: Superfund Amendments and Reauthorization Act
SCBA: Self-Contained Breathing Apparatus
STEL: Short Term Exposure Limit
STP: Standard Temperature and Pressure
TLV: Threshold Limit Value
TSCA: Toxic Substances Control Act
TWA: Time Weighted Average
UEL: Upper Explosive Limit
WHMIS: Workplace Hazardous Materials Information System

Disclaimer:

The information presented herein has been compiled from sources considered to be dependable and is accurate and reliable to the best of our knowledge and belief, but it is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgement.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Date of Revision: Version 1.2 – 9/24/2019 (HSER)
Version 1.1 - 5/5/2018 (EHS&R)
Date of SDS Preparation: 4/7/16
SDS Prepared by: Center for Toxicology and Environmental Health, LLC.

Safety Data Sheet

acc. to OSHA HCS (29CFR 1910.1200) and WHMIS 2015 Regulations

Printing date: October 16, 2018 Revision: October 16, 2018

1 Identification

· **Product identifier**

· **Trade name: Natural Gas Liquids**
· **CAS Number:**
64741-48-6

· **Other means of identification:** NGL, Y-Grade

· **Recommended use and restriction on use**
· **Recommended use:** Raw materials.
· **Restrictions on use:** No relevant information available.

· **Details of the supplier of the Safety Data Sheet**
· **Manufacturer/Supplier:**
Williams, Inc.
One Williams Center
Tulsa, OK 74172
USA
855-945-5762 (Toll-Free)
ehs@williams.com

· **Emergency telephone number:**
CHEMTREC
1-800-424-9300 (US/Canada)
+01 703-527-3887 (International)

2 Hazard(s) identification

· **Classification of the substance or mixture**

Flam. Gas 1	H220	Extremely flammable gas.
Press. Gas	H280	Contains gas under pressure; may explode if heated.
Skin Irrit. 2	H315	Causes skin irritation.
Carc. 1B	H350	May cause cancer.
Repr. 2	H361	Suspected of damaging fertility or the unborn child.
STOT SE 3	H336	May cause drowsiness or dizziness.
STOT RE 2	H373	May cause damage to the nervous system through prolonged or repeated exposure.
Asp. Tox. 1	H304	May be fatal if swallowed and enters airways.

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



GHS02 GHS04 GHS07 GHS08

· **Signal word:** Danger
· **Hazard statements:**
H220 Extremely flammable gas.
H280 Contains gas under pressure; may explode if heated.

(Cont'd. on page 2)

Safety Data Sheet

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Trade name: Natural Gas Liquids

(Cont'd. of page 1)

H315 Causes skin irritation.
H350 May cause cancer.
H361 Suspected of damaging fertility or the unborn child.
H336 May cause drowsiness or dizziness.
H373 May cause damage to the nervous system through prolonged or repeated exposure.
H304 May be fatal if swallowed and enters airways.

· **Precautionary statements:**

P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P233 Keep container tightly closed.
P260 Do not breathe mist/vapors/spray.
P264 Wash thoroughly after handling.
P271 Use only outdoors or in a well-ventilated area.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P301+P310 If swallowed: Immediately call a poison center/doctor.
P331 Do NOT induce vomiting.
P302+P352 If on skin: Wash with plenty of soap and water.
P304+P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P308+P313 IF exposed or concerned: Get medical advice/attention.
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362+P364 Take off contaminated clothing and wash it before reuse.
P377 Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 Eliminate all ignition sources if safe to do so.
P405 Store locked up.
P410+P403 Protect from sunlight. Store in a well-ventilated place.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

· **Other hazards** There are no other hazards not otherwise classified that have been identified.

3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
64741-48-6 Natural gas (petroleum), raw liq. mix

· **Components:**

74-98-6	Propane Flam. Gas 1, H220 Press. Gas, H280 Simple Asphyxiant	<40%
142-82-5	Heptane Flam. Liq. 2, H225 Asp. Tox. 1, H304 Skin Irrit. 2, H315; STOT SE 3, H336	<30%
106-97-8	butane Flam. Gas 1, H220 Press. Gas, H280 Simple Asphyxiant	<25%

(Cont'd. on page 3)

Safety Data Sheet

acc. to OSHA HCS (29CFR 1910.1200) and WHMIS 2015 Regulations

Printing date: October 16, 2018 Revision: October 16, 2018

Trade name: Natural Gas Liquids

(Cont'd. of page 2)

78-78-4	isopentane Flam. Liq. 1, H224 Asp. Tox. 1, H304 STOT SE 3, H336	<15%
75-28-5	isobutane Flam. Gas 1, H220 Press. Gas, H280 Simple Asphyxiant	<10%
74-84-0	Ethane Flam. Gas 1, H220 Press. Gas, H280 Simple Asphyxiant	<10%
111-65-9	octane Flam. Liq. 2, H225 Asp. Tox. 1, H304 Skin Irrit. 2, H315; STOT SE 3, H336	<10%
109-66-0	pentane Flam. Liq. 2, H225 Asp. Tox. 1, H304 STOT SE 3, H336	<10%
110-54-3	n-hexane Flam. Liq. 2, H225 Repr. 2, H361; STOT RE 2, H373; Asp. Tox. 1, H304 Skin Irrit. 2, H315; STOT SE 3, H336 Eye Irrit. 2B, H320	<8%
107-83-5	Isohexane Flam. Liq. 2, H225 Asp. Tox. 1, H304 Skin Irrit. 2, H315; STOT SE 3, H336	<6%
124-18-5	decane Flam. Liq. 3, H226 Asp. Tox. 1, H304	<5%
111-84-2	nonane Flam. Liq. 3, H226 Asp. Tox. 1, H304 Skin Irrit. 2, H315; STOT SE 3, H335	<5%
96-14-0	3-methylpentane Flam. Liq. 2, H225 Asp. Tox. 1, H304 Skin Irrit. 2, H315; STOT SE 3, H336	<5%
75-83-2	2,2-dimethylbutane Flam. Liq. 2, H225 Asp. Tox. 1, H304 Skin Irrit. 2, H315; STOT SE 3, H336	<5%
71-43-2	benzene Flam. Liq. 2, H225 Muta. 1B, H340; Carc. 1A, H350; STOT RE 1, H372; Asp. Tox. 1, H304 Skin Irrit. 2, H315; Eye Irrit. 2A, H319	<0.1%

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7783-06-4	Hydrogen sulfide / Hydrogen sulphide Flam. Gas 1, H220 Press. Gas, H280 Acute Tox. 2, H330	<0.01%

· **Additional information:**
For the listed ingredient(s), the identity and/or exact percentage(s) are being withheld as a trade secret.
For the wording of the listed Hazard Statements, refer to section 16.

4 First-aid measures

· **Description of first aid measures**
· **After inhalation:**
Supply fresh air.
Provide oxygen treatment if affected person has difficulty breathing.
If experiencing respiratory symptoms: Call a poison center/doctor.
In case of unconsciousness place patient stably in side position for transportation.
· **After skin contact:**
Immediately remove any clothing soiled by the product.
Immediately wash with water and soap and rinse thoroughly.
If skin irritation or rash occurs: Get medical advice/attention.
· **After eye contact:**
Remove contact lenses if worn.
Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.
· **After swallowing:**
Rinse out mouth and then drink plenty of water.
Do not induce vomiting; immediately call for medical help.
A person vomiting while lying on their back should be turned onto their side.
· **Most important symptoms and effects, both acute and delayed:**
Breathing difficulty
Dizziness
Coughing
Gastric or intestinal disorders when ingested.
Irritant to skin and mucous membranes.
Nausea in case of ingestion.
Headache
Acne
Disorientation
· **Danger:**
Vapors may cause drowsiness and dizziness.
Condition may deteriorate with alcohol consumption.
May be fatal if swallowed and enters airways.
Suspected of damaging fertility or the unborn child.
May cause cancer.
· **Indication of any immediate medical attention and special treatment needed:**
If medical advice is needed, have product container or label at hand.

5 Fire-fighting measures

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· **Extinguishing media**
· **Suitable extinguishing agents:**
Foam
Gaseous extinguishing agents
Carbon dioxide
Water fog / haze
Fire-extinguishing powder
· **For safety reasons unsuitable extinguishing agents:**
Water stream.
Water spray
· **Special hazards arising from the substance or mixture**
Highly flammable liquid and vapor.
Danger of receptacles bursting because of high vapor pressure if heated.
Hazardous gases may be released if heated above the decomposition point.
· **Advice for firefighters**
· **Protective equipment:**
Wear self-contained respiratory protective device.
Wear fully protective suit.
· **Additional information:** Eliminate all ignition sources if safe to do so.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures**
Isolate area and prevent access.
Wear protective equipment. Keep unprotected persons away.
For large spills, use respiratory protective device against the effects of fumes/dust/aerosol.
Ensure adequate ventilation.
Keep away from ignition sources.
Particular danger of slipping on leaked/spilled product.
· **Environmental precautions**
Do not allow to enter sewers/ surface or ground water.
Prevent from spreading (e.g. by damming-in or oil barriers).
Report spills to authorities as required.
· **Methods and material for containment and cleaning up**
Allow to evaporate.
Absorb liquid components with non-combustible liquid-binding material.
Use spark-proof equipment.
Send for recovery or disposal in suitable receptacles.
· **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

· **Handling**
· **Precautions for safe handling:**

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Prevent formation of aerosols.
Avoid splashes or spray in enclosed areas.
Use only in well ventilated areas.

· **Information about protection against explosions and fires:**
Highly flammable liquid and vapor.
Keep ignition sources away - Do not smoke.
Protect from heat.
Protect against electrostatic charges.
Flammable gas-air mixtures may be formed in empty containers/receptacles.

· **Conditions for safe storage, including any incompatibilities**

· **Requirements to be met by storerooms and receptacles:**
Avoid storage near extreme heat, ignition sources or open flame.
Store in cool, dry conditions in well sealed receptacles.

· **Information about storage in one common storage facility:**
Store away from foodstuffs.
Store away from oxidizing agents.

· **Specific end use(s)** No relevant information available.

8 Exposure controls/personal protection

· **Control parameters**

· **Components with limit values that require monitoring at the workplace:**	
110-54-3 n-hexane	
PEL (USA)	Long-term value: 1800 mg/m³, 500 ppm
REL (USA)	Long-term value: 180 mg/m³, 50 ppm
TLV (USA)	Long-term value: 176 mg/m³, 50 ppm Skin; BEI
EL (Canada)	Long-term value: 20 ppm Skin
EV (Canada)	Long-term value: 176 mg/m³, 50 ppm
LMPE (Mexico)	Long-term value: 50 ppm PIEL, IBE
142-82-5 Heptane	
PEL (USA)	Long-term value: 2000 mg/m³, 500 ppm
REL (USA)	Long-term value: 350 mg/m³, 85 ppm Ceiling limit value: 1800* mg/m³, 440* ppm *15-min
TLV (USA)	Short-term value: 2050 mg/m³, 500 ppm Long-term value: 1640 mg/m³, 400 ppm
EL (Canada)	Short-term value: 500 ppm Long-term value: 400 ppm
EV (Canada)	Short-term value: 2045 mg/m³, 500 ppm Long-term value: 1635 mg/m³, 400 ppm
LMPE (Mexico)	Short-term value: 500 ppm Long-term value: 400 ppm

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106-97-8 butane	
REL (USA)	Long-term value: 1900 mg/m³, 800 ppm
TLV (USA)	Short-term value: 2370 mg/m³, 1000 ppm (EX)
EL (Canada)	Short-term value: 1000 ppm EX
EV (Canada)	Long-term value: 800 ppm revoked as of 01/01/18
LMPE (Mexico)	Long-term value: 1000 ppm
78-78-4 isopentane	
PEL (USA)	Long-term value: 2950 mg/m³, 1000 ppm
TLV (USA)	Long-term value: 2950 mg/m³, 1000 ppm
EL (Canada)	Long-term value: 1000 ppm
EV (Canada)	Short-term value: 2,210 mg/m³, 750 ppm Long-term value: 1,770 mg/m³, 600 ppm
LMPE (Mexico)	Long-term value: 600 ppm
75-28-5 isobutane	
TLV (USA)	Short-term value: 2370 mg/m³, 1000 ppm (EX)
EL (Canada)	Short-term value: 1000 ppm EX
EV (Canada)	Long-term value: 800 ppm revoked as of 01/01/18
LMPE (Mexico)	Long-term value: 1000 ppm
74-84-0 Ethane	
TLV (USA)	Refer to Appendix F in TLVs & BEIs book; (D, EX)
EL (Canada)	simple asphyxiant; EX
EV (Canada)	Long-term value: 1,000 ppm revoked as of 01/01/18
LMPE (Mexico)	Long-term value: 1000 ppm
111-65-9 octane	
PEL (USA)	Long-term value: 2350 mg/m³, 500 ppm n-Octane only
REL (USA)	Long-term value: 350 mg/m³, 75 ppm Ceiling limit value: 1800* mg/m³, 385* ppm *15 min
TLV (USA)	Long-term value: 1401 mg/m³, 300 ppm
EL (Canada)	Long-term value: 300 ppm
EV (Canada)	Short-term value: 1,750 mg/m³, 375 ppm Long-term value: 1,400 mg/m³, 300 ppm
LMPE (Mexico)	Long-term value: 300 ppm
74-98-6 Propane	
PEL (USA)	Long-term value: 1800 mg/m³, 1000 ppm

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REL (USA)	Long-term value: 1800 mg/m³, 1000 ppm
TLV (USA)	refer to Appendix F inTLVs&BEIs book; D, EX
EL (Canada)	Simple asphyxiant; EX
EV (Canada)	Long-term value: 1,000 ppm revoked as of 01/01/18
LMPE (Mexico)	Long-term value: 1000 ppm
107-83-5 Isohexane	
REL (USA)	Long-term value: 350 mg/m³, 100 ppm Ceiling limit value: 1800* mg/m³, 510* ppm *15-min
TLV (USA)	Short-term value: 3500 mg/m³, 1000 ppm Long-term value: 1760 mg/m³, 500 ppm
EL (Canada)	Long-term value: 200 ppm
LMPE (Mexico)	Short-term value: 1000 ppm Long-term value: 500 ppm
111-84-2 nonane	
REL (USA)	Long-term value: 1050 mg/m³, 200 ppm
TLV (USA)	Long-term value: 1050 mg/m³, 200 ppm
EL (Canada)	Long-term value: 200 ppm
EV (Canada)	Long-term value: 1,050 mg/m³, 200 ppm
LMPE (Mexico)	Long-term value: 200 ppm
96-14-0 3-methylpentane	
REL (USA)	Long-term value: 350 mg/m³, 100 ppm Ceiling limit value: 1800* mg/m³, 510* ppm *15-min
TLV (USA)	Short-term value: 3500 mg/m³, 1000 ppm Long-term value: 1760 mg/m³, 500 ppm
EL (Canada)	Long-term value: 200 ppm
LMPE (Mexico)	Short-term value: 1000 ppm Long-term value: 500 ppm
75-83-2 2,2-dimethylbutane	
REL (USA)	Long-term value: 350 mg/m³, 100 ppm Ceiling limit value: 1800* mg/m³, 510* ppm *15-min
TLV (USA)	Short-term value: 3500 mg/m³, 1000 ppm Long-term value: 1760 mg/m³, 500 ppm
EL (Canada)	Long-term value: 200 ppm
LMPE (Mexico)	Short-term value: 1000 ppm Long-term value: 500 ppm
7783-06-4 Hydrogen sulfide / Hydrogen sulphide	
PEL (USA)	Ceiling limit value: 20; 50* ppm *10-min peak; once per 8-hr shift
REL (USA)	Ceiling limit value: 15* mg/m³, 10* ppm *10-min

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TLV (USA)	Short-term value: 7 mg/m³, 5 ppm Long-term value: 1.4 mg/m³, 1 ppm
EL (Canada)	Ceiling limit value: 10 ppm
EV (Canada)	Short-term value: 15 ppm Long-term value: 10 ppm
LMPE (Mexico)	Short-term value: 5 ppm Long-term value: 1 ppm

· **Ingredients with biological limit values:**

110-54-3 n-hexane

BEI (USA)	0.4 mg/L Medium: urine Time: end of shift at end of workweek Parameter: 2.5-Hexanedione without hydrolysis

· **Exposure controls**

· **General protective and hygienic measures:**
The usual precautionary measures for handling chemicals should be followed.
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Store protective clothing separately.
Avoid contact with the eyes and skin.

· **Engineering controls:** Provide adequate ventilation.

· **Breathing equipment:**



Self-contained respiratory protective device should be used in case of large spills or leaks.

· **Protection of hands:**



Protective gloves

The glove material has to be impermeable and resistant to the product.

· **Eye protection:**



Safety glasses

Follow relevant national guidelines concerning the use of protective eyewear.

· **Body protection:** Wear appropriate protective clothing.

· **Limitation and supervision of exposure into the environment**
No relevant information available.

· **Risk management measures** No relevant information available.

9 Physical and chemical properties

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· **Information on basic physical and chemical properties**	
· **Appearance:**	
Form:	Liquefied gas
Color:	Colorless
· **Odor:**	Gasoline-like or natural gas odor. May contain hydrogen sulfide, which has a rotten egg odor.
· **Odor threshold:**	Not determined.
· **pH-value:**	Not determined.
· **Melting point/Melting range:**	Not determined.
· **Boiling point/Boiling range:**	Not determined.
· **Flash point:**	-73 °C (-99.4 °F)
· **Flammability (solid, gaseous):**	Not applicable.
· **Auto-ignition temperature:**	Not determined.
· **Decomposition temperature:**	Not determined.
· **Danger of explosion:**	Product is not explosive. However, formation of explosive air/ vapor mixtures are possible.
· **Explosion limits**	
Lower:	Not determined.
Upper:	Not determined.
· **Oxidizing properties:**	Not determined.
· **Vapor pressure at 37.8 °C (100 °F):**	7757-10343 mmHg (150-200 psia)
· **Density at 20 °C (68 °F):**	0.5-0.7 g/cm³ (4.17-5.84 lbs/gal) (Estimated Range)
· **Relative density:**	Not determined.
· **Vapor density:**	Not determined.
· **Relative vapor density at 20 °C (68 °F):**	> 1 (air = 1)
· **Evaporation rate:**	Not determined.
· **Solubility in / Miscibility with**	
Water:	Not miscible or difficult to mix.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity**	
Dynamic:	Not determined.
Kinematic:	Not determined.
· **Other information**	No relevant information available.

10 Stability and reactivity

· **Reactivity:** No data available for self-reactivity.
· **Chemical stability:** Stable under normal temperatures and pressures.
· **Thermal decomposition / conditions to be avoided:**
No decomposition if used and stored according to specifications.
· **Possibility of hazardous reactions**

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Highly flammable liquid and vapor.
Reacts with oxidizing agents.
Used empty containers may contain product gases which form explosive mixtures with air.
Can form explosive mixtures in air if heated above flash point and/or when sprayed or atomized.
Hazardous gases may be released if heated above the decomposition point.

· **Conditions to avoid**
Excessive heat.
Keep ignition sources away - Do not smoke.

· **Incompatible materials** Oxidizers

· **Hazardous decomposition products**
Under fire conditions only:
Carbon monoxide and carbon dioxide

11 Toxicological information

· **Information on toxicological effects**

· **Acute toxicity:** Based on available data, the classification criteria are not met.

· **LD/LC50 values that are relevant for classification:**		
7783-06-4 Hydrogen sulfide / Hydrogen sulphide		
Inhalative	LC50/4h	444 ppm (rat)
	LC50/4h	621 mg/m3 (rat)
71-43-2 benzene		
Oral	LD50	4,894 mg/kg (rat)
Inhalative	LC50/4h	9,980 mg/l (mouse)

· **Primary irritant effect:**
· **On the skin:** Irritant to skin and mucous membranes.
· **On the eye:** Based on available data, the classification criteria are not met.
· **Sensitization:** Based on available data, the classification criteria are not met.

· **IARC (International Agency for Research on Cancer):**		
71-43-2	benzene	1

· **NTP (National Toxicology Program):**		
71-43-2	benzene	K

· **OSHA-Ca (Occupational Safety & Health Administration):**	
71-43-2	benzene

· **Probable route(s) of exposure:**
Ingestion.
Inhalation.
Eye contact.
Skin contact.
· **Germ cell mutagenicity:** Based on available data, the classification criteria are not met.
· **Carcinogenicity:** May cause cancer.
· **Reproductive toxicity:** Suspected of damaging fertility or the unborn child.
· **STOT-single exposure:** May cause drowsiness or dizziness.
· **STOT-repeated exposure:** Based on available data, the classification criteria are not met.
· **Aspiration hazard:** May be fatal if swallowed and enters airways.

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12 Ecological information

· **Toxicity**
· **Aquatic toxicity** Toxic to aquatic life with long lasting effects.
· **Persistence and degradability** No relevant information available.
· **Bioaccumulative potential:** No relevant information available.
· **Mobility in soil:** No relevant information available.
· **Additional ecological information**
· **General notes:**
Do not allow product to reach ground water, water course or sewage system, even in small quantities.
Danger to drinking water if even extremely small quantities leak into the ground.
Due to available data on eliminability/decomposition and bioaccumulation potential prolonged term damage of the environment can not be excluded.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Other adverse effects** No relevant information available.

13 Disposal considerations

· **Waste treatment methods**
· **Recommendation:**
Contact waste processors for recycling information.
The user of this material has the responsibility to dispose of unused material, residues and containers in compliance with all relevant local, state and federal laws and regulations regarding treatment, storage and disposal for hazardous and nonhazardous wastes.

· **Uncleaned packagings**
· **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

· **UN-Number**	
· **DOT, ADR, IMDG, IATA**	UN1965 or UN3295
· **UN proper shipping name**	
· **DOT, IATA**	Hydrocarbon gas mixture, liquefied, n.o.s. (Propane, Butane) or Hydrocarbons, liquid, n.o.s.
· **ADR, IMDG**	HYDROCARBON GAS MIXTURE, LIQUEFIED, N.O.S. (PROPANE, BUTANE) or HYDROCARBONS, LIQUID, N.O.S.
· **Transport hazard class(es)**	

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· **DOT**



· **Class**	2.1 or 3
· **Label**	2.1 or 3

· **ADR**



· **Class**	2.1 2F or 3 F1
· **Label**	2.1 or 3

· **IMDG, IATA**



· **Class**	2.1 or 3
· **Label**	2.1 or 3

· **Packing group**	
· **DOT, ADR, IMDG, IATA**	None (gas) or I (BP < 35 °C) or II (BP >35 °C)
· **Environmental hazards**	Product contains environmentally hazardous substances: Heptane
· **Marine pollutant:**	
 Yes	
· **Special precautions for user**	Warning: Flammable liquids or gases
· **Danger code (Kemler):**	21 or 33
· **EMS Number:**	F-D, S-
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.

15 Regulatory information

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

· **United States (USA)**

· **SARA**

· **Section 302 (extremely hazardous substances):**

Substance is not listed.

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· **Section 355 (extremely hazardous substances):**

7783-06-4	Hydrogen sulfide / Hydrogen sulphide

· **Section 313 (Specific toxic chemical listings):**

110-54-3	n-hexane

· **TSCA (Toxic Substances Control Act)**

Substance is listed.

· **Proposition 65 (California)**

· **Chemicals known to cause cancer:**

71-43-2	benzene

· **Chemicals known to cause developmental toxicity for females:**

Substance is not listed.

· **Chemicals known to cause developmental toxicity for males:**

110-54-3	n-hexane
71-43-2	benzene

· **Chemicals known to cause developmental toxicity:**

71-43-2	benzene

· **EPA (Environmental Protection Agency):**

110-54-3	n-hexane	II
7783-06-4	Hydrogen sulfide / Hydrogen sulphide	I

· **IARC (International Agency for Research on Cancer):**

71-43-2	benzene	1

· **Canadian Domestic Substances List (DSL) (Substances not listed.):**

Substance is listed.

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.

· **Abbreviations and acronyms:**

ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
CAS: Chemical Abstracts Service (division of the American Chemical Society)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
PBT: Persistant, Bio-accumulable, Toxic
vPvB: very Persistent and very Bioaccumulative
OSHA: Occupational Safety & Health Administration
Flam. Gas 1: Flammable gases – Category 1
Press. Gas: Gases under pressure – Compressed gas
Press. Gas: Gases under pressure – Dissolved gas
Flam. Liq. 1: Flammable liquids – Category 1
Flam. Liq. 2: Flammable liquids – Category 2
Flam. Liq. 3: Flammable liquids – Category 3
Acute Tox. 2: Acute toxicity – Category 2
Skin Irrit. 2: Skin corrosion/irritation – Category 2

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Eye Irrit. 2A: Serious eye damage/eye irritation – Category 2A
Eye Irrit. 2B: Serious eye damage/eye irritation – Category 2B
Muta. 1B: Germ cell mutagenicity – Category 1B
Carc. 1A: Carcinogenicity – Category 1A
Carc. 1B: Carcinogenicity – Category 1B
Repr. 2: Reproductive toxicity – Category 2
STOT SE 3: Specific target organ toxicity (single exposure) – Category 3
STOT RE 1: Specific target organ toxicity (repeated exposure) – Category 1
STOT RE 2: Specific target organ toxicity (repeated exposure) – Category 2
Asp. Tox. 1: Aspiration hazard – Category 1

· **Sources**

Website, European Chemicals Agency (echa.europa.eu)
Website, US EPA Substance Registry Services (ofmpub.epa.gov/sor internet/registry/substreg/home/overview/home.do)
Website, Chemical Abstracts Registry, American Chemical Society (www.cas.org)
Patty's Industrial Hygiene, 6th ed., Rose, Vernon, ed. ISBN: 978-0-470-07488-6
Casarett and Doull's Toxicology: The Basic Science of Poisons, 8th Ed., Klaasen, Curtis D., ed., ISBN: 978-0-07-176923-5.
Safety Data Sheets, Individual Manufacturers

SDS Prepared by:
ChemTel Inc.
1305 North Florida Avenue
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Website: www.chemtelinc.com

ThermoFisher SCIENTIFIC

SAFETY DATA SHEET

Creation Date 12-Mar-2009 **Revision Date** 24-Dec-2021 **Revision Number** 9

1. Identification

Product Name **Nitric acid (67 - 70%)**

Cat No. : **A467-1, A467-2, A467-250, A467-500**

CAS No 7697-37-2
Synonyms Azotic acid; Engraver's acid; Aqua fortis

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company
Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number Chemtrec US: (800) 424-9300
Chemtrec EU: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Oxidizing liquids	Category 3
Corrosive to metals	Category 1
Acute Inhalation Toxicity - Vapors	Category 3
Skin Corrosion/Irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1

Label Elements

Signal Word
Danger

Hazard Statements
May intensify fire; oxidizer
May be corrosive to metals
Causes severe skin burns and eye damage

Toxic if inhaled
Corrosive to the respiratory tract



Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep/Store away from clothing/ other combustible materials
Take any precaution to avoid mixing with combustibles
Keep only in original container
Wear respiratory protection
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Immediately call a POISON CENTER or doctor/physician
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Spills
Absorb spillage to prevent material damage
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Store in a dry place
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Corrosive to the respiratory tract

3. Composition/Information on Ingredients

Component	CAS No	Weight %
Nitric acid …% [C ≤ 70 %]	7697-37-2	65 - 70
Water	7732-18-5	30 - 35

4. First-aid measures

General Advice Immediate medical attention is required. Show this safety data sheet to the doctor in

attendance.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Call a physician immediately.

Inhalation If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Remove from exposure, lie down. Call a physician immediately.

Ingestion Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Clean mouth with water. Call a physician immediately.

Most important symptoms and effects Causes burns by all exposure routes. Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media CO_2, dry chemical, dry sand, alcohol-resistant foam.

Unsuitable Extinguishing Media No information available

Flash Point Not applicable
Method - No information available

Autoignition Temperature No information available
Explosion Limits
Upper No data available
Lower No data available
Oxidizing Properties Oxidizer

Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. The product causes burns of eyes, skin and mucous membranes. Oxidizer: Contact with combustible/organic material may cause fire. May ignite combustibles (wood paper, oil, clothing, etc.).

Hazardous Combustion Products
Nitrogen oxides (NOx). Thermal decomposition can lead to release of irritating gases and vapors.
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
4	0	0	OX

6. Accidental release measures

Personal Precautions Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Use personal protective equipment as required.

Environmental Precautions Should not be released into the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional Ecological Information.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Sweep up and shovel into suitable containers for disposal. Wear self-contained breathing apparatus and protective suit.

7. Handling and storage

Handling Use only under a chemical fume hood. Wear personal protective equipment/face protection. Do not get in eyes, on skin, or on clothing. Do not ingest. If swallowed then seek immediate medical assistance. Do not breathe mist/vapors/spray. Keep away from clothing and other combustible materials.

Storage. Keep containers tightly closed in a dry, cool and well-ventilated place. Do not store near combustible materials. Do not store in metal containers. Keep in properly labeled containers. Corrosives area. Incompatible Materials. Combustible material. Strong bases. Reducing Agent. Metals. Finely powdered metals. Organic materials. Aldehydes. Alcohols. Cyanides. Ammonia. Strong reducing agents.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Nitric acid …% [C ≤ 70 %]	TWA: 2 ppm STEL: 4 ppm	(Vacated) TWA: 2 ppm (Vacated) TWA: 5 mg/m^3 (Vacated) STEL: 4 ppm (Vacated) STEL: 10 mg/m^3 TWA: 2 ppm TWA: 5 mg/m^3	IDLH: 25 ppm TWA: 2 ppm TWA: 5 mg/m^3 STEL: 4 ppm STEL: 10 mg/m^3	TWA: 2 ppm STEL: 4 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: NIOSH - National Institute for Occupational Safety and Health

Engineering Measures Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166. Tight sealing safety goggles. Face protection shield.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Keep away from food, drink and animal feeding stuffs. When using do not eat, drink or smoke. Contaminated work clothing should not be allowed out of the workplace. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes or clothing. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Wear suitable gloves and eye/face protection.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Clear Colorless, Light yellow
Odor	Strong Acrid
Odor Threshold	No information available
pH	< 1.0 (0.1M)
Melting Point/Range	-41 °C / -41.8 °F
Boiling Point/Range	Not applicable
Flash Point	Not applicable
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	0.94 kPa (20°C)
Vapor Density	No information available
Specific Gravity	1.40
Solubility	miscible
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	HNO3
Molecular Weight	63.01

10. Stability and reactivity

Reactive Hazard Yes

Stability Oxidizer: Contact with combustible/organic material may cause fire.

Conditions to Avoid Incompatible products. Combustible material. Excess heat. Exposure to air or moisture over prolonged periods.

Incompatible Materials Combustible material, Strong bases, Reducing Agent, Metals, Finely powdered metals, Organic materials, Aldehydes, Alcohols, Cyanides, Ammonia, Strong reducing agents

Hazardous Decomposition Products Nitrogen oxides (NOx), Thermal decomposition can lead to release of irritating gases and vapors

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50	Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Dermal LD50	Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Mist LC50	Category 3. ATE = 1 - 5 mg/l. Category 4.
Vapor LC50	Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Nitric acid …% [C ≤ 70 %]	Not listed	Not listed	LC50 = 2500 ppm. (Rat) 1h
Water	-	-	-

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes severe burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS No	IARC	NTP	ACGIH	OSHA	Mexico
Nitric acid …% [C ≤ 70 %]	7697-37-2	Not listed	Not listed	Not listed	Not listed	Not listed
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity
Do not empty into drains. Large amounts will affect pH and harm aquatic organisms.

Persistence and Degradability Miscible with water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Nitric acid …% [C ≤ 70 %]	-2.3

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT
UN-No UN2031
Proper Shipping Name NITRIC ACID
Hazard Class 8
Subsidiary Hazard Class 5.1
Packing Group II

TDG
UN-No UN2031

Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IATA

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IMDG/IMO

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

15. Regulatory information

United States of America Inventory

Component	CAS No	TSCA	TSCA Inventory notification - Active-Inactive	TSCA - EPA Regulatory Flags
Nitric acid …% [C ≤ 70 %]	7697-37-2	X	ACTIVE	-
Water	7732-18-5	X	ACTIVE	-

Legend:
TSCA US EPA (TSCA) - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Japan (ISHL), Australia (AICS), China (IECSC), Korea (KECL).

Component	CAS No	DSL	NDSL	EINECS	PICCS	ENCS	ISHL	AICS	IECSC	KECL
Nitric acid …% [C ≤ 70 %]	7697-37-2	X	-	231-714-2	X	X	X	X	X	KE-25911
Water	7732-18-5	X	-	231-791-2	X	X		X	X	KE-35400

KECL - NIER number or KE number (http://ncis.nier.go.kr/en/main.do)

U.S. Federal Regulations

SARA 313

Component	CAS No	Weight %	SARA 313 - Threshold Values %
Nitric acid …% [C ≤ 70 %]	7697-37-2	65 - 70	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Nitric acid …% [C ≤ 70 %]	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Nitric acid …% [C ≤ 70 %]	-	TQ: 500 lb

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Nitric acid …% [C ≤ 70 %]	1000 lb	1000 lb

California Proposition 65 This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Nitric acid …% [C ≤ 70 %]	X	X	X	X	X
Water	-	-	X	-	-

U.S. Department of Transportation
Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security This product contains the following DHS chemicals:
Legend - STQs = Screening Threshold Quantities, APA = A placarded amount

Component	DHS Chemical Facility Anti-Terrorism Standard
Nitric acid …% [C ≤ 70 %]	Release STQs - 15000lb Theft STQs - 400lb

Other International Regulations

Mexico - Grade No information available

Authorisation/Restrictions according to EU REACH

Component	REACH (1907/2006) - Annex XIV - Substances Subject to Authorization	REACH (1907/2006) - Annex XVII - Restrictions on Certain Dangerous Substances	REACH Regulation (EC 1907/2006) article 59 - Candidate List of Substances of Very High Concern (SVHC)
Nitric acid …% [C ≤ 70 %]	-	Use restricted. See item 75. (see link for restriction details)	-

https://echa.europa.eu/substances-restricted-under-reach

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

Component	CAS No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
Nitric acid …% [C ≤ 70 %]	7697-37-2	Listed	Not applicable	Not applicable	Not applicable
Water	7732-18-5	Listed	Not applicable	Not applicable	Not applicable

Component	CAS No	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Major Accident Notification	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Rotterdam Convention (PIC)	Basel Convention (Hazardous Waste)
Nitric acid …% [C ≤ 70 %]	7697-37-2	Not applicable	Not applicable	Not applicable	Annex I - Y34
Water	7732-18-5	Not applicable	Not applicable	Not applicable	Not applicable

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date	12-Mar-2009
Revision Date	24-Dec-2021
Print Date	24-Dec-2021
Revision Summary	SDS sections updated. 2. 11.

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

Safety Data Sheet: **Simple Green® All-Purpose Cleaner** ★

Version No. 13000-21A Issue Date: February 1, 2021 Supersedes Date: August 8, 2018 *OSHA HCS-2012 / GHS*

Section 1: IDENTIFICATION

Product Name: Simple Green® All-Purpose Cleaner
Additional Names:

Manufacturer's Part Number: **Please refer to Section 16*

Recommended Use: Cleaner & Degreaser for water tolerant surfaces.
Restrictions on Use: Do not use on non-rinseable surfaces.

Company: Sunshine Makers, Inc.
15922 Pacific Coast Highway
Huntington Beach, CA 92649 USA
Telephone: 800-228-0709 ● 562-795-6000 *Mon – Fri, 8am – 5pm PST*
Fax: 562-592-3830
Email: info@simplegreen.com
Emergency Phone: Chem-Tel 24-Hour Emergency Service: 800-255-3924

Section 2: HAZARDS IDENTIFICATION

This product is not considered hazardous under 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

OSHA HCS 2012
Label Elements
Signal Word: None **Hazard Symbol(s)/Pictogram(s):** None required
Hazard Statements: None
Precautionary Statements: None
Hazards Not Otherwise Classified (HNOC): None
Other Information: None Known

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	CAS Number	Percent Range
Water	7732-18-5	> 80.698%*
C9-11 Alcohols Ethoxylated	68439-46-3	< 5.000%*
Surfactant	Proprietary	< 5.000%*
Sodium Citrate	68-04-2	< 5.000%*
Sodium Carbonate	497-19-8	< 1.000%*
Tetrasodium Glutamate Diacetate	51981-21-6	< 1.000%*
Citric Acid	77-92-9	< 1.000%*
Blend of Polyoxyalkylene Substituted Chromophores (Cyan and Yellow)	Proprietary Mixture	< 0.100%*
Fragrances	Proprietary Mixture	< 1.000%*
Anethole	104-46-1	< 0.100%*
Eucalyptol	470-82-6	< 0.100%*
Methylchloroisothiazolinone	26172-55-4	< 0.001%*
Methylisothiazolinone	2682-20-4	< 0.0001%*

**specific percentages of composition are being withheld as a trade secret*

Section 4: FIRST-AID MEASURES

Inhalation: Not expected to cause respiratory irritation. If adverse effect occurs, move to fresh air.
Skin Contact: Not expected to cause skin irritation. If adverse effect occurs, rinse skin with water.
Eye Contact: Not expected to cause eye irritation. If adverse effect occurs, flush eyes with water.
Ingestion: May cause upset stomach. Drink plenty of water to dilute. See section 11.
Most Important Symptoms/Effects, Acute and Delayed: None known.

Section 4: FIRST-AID MEASURES - continued

Indication of Immediate Medical Attention and Special Treatment Needed, if necessary: Treat symptomatically

Section 5: FIRE-FIGHTING MEASURES

Suitable & Unsuitable Extinguishing Media: Use Dry chemical, CO2, water spray or "alcohol" foam. Avoid high volume jet water.
Specific Hazards Arising from Chemical: In event of fire, fire created carbon oxides may be formed.
Special Protective Actions for Fire-Fighters: Wear positive pressure self-contained breathing apparatus; Wear full protective clothing.

This product is non-flammable. See Section 9 for Physical Properties.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures: *For non-emergency and emergency personnel:* See section 8 – personal protection. Avoid eye contact. Safety goggles suggested.

Environmental Precautions: Do not allow into open waterways and ground water systems.

Methods and Materials for Containment and Clean Up: Dike or soak up with inert absorbent material. See section 13 for disposal considerations.

Section 7: HANDLING AND STORAGE

Precautions for Safe Handling: Ensure adequate ventilation. Keep out of reach of children. Keep away from heat, sparks, open flame and direct sunlight. Do not pierce any part of the container. Do not mix or contaminate with any other chemical. Do not eat, drink or smoke while using this product.

Conditions for Safe Storage including Incompatibilities: Keep container tightly closed. Keep in cool dry area. Avoid prolonged exposure to sunlight. Do not store at temperatures above 109°F (42.7°C). If separation occurs, mix the product for reconstitution.

Section 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Limit Values: No components listed with TWA or STEL values under OSHA or ACGIH.

Appropriate Engineering Controls: Showers, eyewash stations, ventilation systems

Individual Protection Measures / Personal Protective Equipment (PPE)
Eye Contact: Use protective glasses or safety goggles if splashing or spray-back is likely.
Respiratory: Use in well ventilated areas or local exhaust ventilations when cleaning small spaces.
Skin Contact: Use protective gloves (any material) when used for prolonged periods or dermally sensitive.
General Hygiene Considerations: Wash thoroughly after handling and before eating or drinking.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Green Liquid	**Partition Coefficient: n-octanol/water:**	Not determined
Odor:	Added sassafras odor	**Autoignition Temperature:**	Non-flammable
Odor Threshold:	Not determined	**Decomposition Temperature:**	42.7°C (109°F)
pH:	8.5 – 9.2	**Viscosity:**	Like water
Freezing Point:	0-3.33°C (32-38°F)	**Specific Gravity:**	1.01 – 1.03
Boiling Point & Range:	101°C (213.8°F)	**VOCs:**	***Water & fragrance exemption in calculation*

Section 9: PHYSICAL AND CHEMICAL PROPERTIES - continued

Flash Point:	> 212°F	SCAQMD 304-91 / EPA 24:	0 g/L	0 lb/gal	0%
Evaporation Rate:	Not determined	CARB Method 310**:	< 5 g/L	<0.0417lb/gal	<0.5%
Flammability (solid, gas):	Not applicable	SCAQMD Method 313:	Not tested		
Upper/Lower Flammability or Explosive Limits:	Not applicable	**VOC Composite Partial Pressure:**	Not determined		
Vapor Pressure:	0.60 PSI @77°F, 2.05 PSI @100°F	**Relative Density:**	8.42 – 8.59 lb/gal		
Vapor Density:	Not determined	**Solubility:**	100% in water		

Section 10: STABILITY AND REACTIVITY

Reactivity: Non-reactive.
Chemical Stability: Stable under normal conditions 70°F (21°C) and 14.7 psig (760 mmHg).
Possibility of Hazardous Reactions: None known.
Conditions to Avoid: Excessive heat or cold.
Incompatible Materials: Do not mix with oxidizers, acids, bathroom cleaners, or disinfecting agents.
Hazardous Decomposition Products: Normal products of combustion - CO, CO2.

Section 11: TOXICOLOGICAL INFORMATION

Likely Routes of Exposure:
Inhalation - Overexposure may cause headache.
Skin Contact - Not expected to cause irritation, repeated contact may cause dry skin.
Eye Contact - Not expected to cause irritation.
Ingestion - May cause upset stomach.

Symptoms related to the physical, chemical and toxicological characteristics: no symptoms expected under typical use conditions.
Delayed and immediate effects and or chronic effects from short term exposure: no symptoms expected under typical use conditions.
Delayed and immediate effects and or chronic effects from long term exposure: headache, dry skin, or skin irritation may occur.
Interactive effects: Not known.

Numerical Measures of Toxicity
Acute Toxicity: Oral LD_{50} (rat) > 5 g/kg body weight
Dermal LD_{50} (rabbit) > 5 g/kg body weight
Calculated via OSHA HCS 2012 / Globally Harmonized System of Classification and Labelling of Chemicals

Skin Corrosion/Irritation: Non-irritant per Dermal Irritection® assay modeling. No animal testing performed.
Eye Damage/Irritation: Non-irritant per Ocular Irritection® assay modeling. No animal testing performed.
Germ Cell Mutagenicity: Mixture does not classify under this category.
Carcinogenicity: Mixture does not classify under this category.
Reproductive Toxicity: Mixture does not classify under this category.
STOT-Single Exposure: Mixture does not classify under this category.
STOT-Repeated Exposure: Mixture does not classify under this category.
Aspiration Hazard: Mixture does not classify under this category.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity: Volume of ingredients used does not trigger toxicity classifications under the Globally Harmonized System of Classification and Labelling of Chemicals.
Aquatic: Aquatic Toxicity - Low, based on OECD 201, 202, 203 + Microtox: EC_{50} & IC_{50} ≥100 mg/L. Volume of ingredients used does not trigger toxicity classifications under the Globally Harmonized System of Classification and Labelling of Chemicals.
Terrestrial: Not tested on finished formulation.

Section 12: ECOLOGICAL INFORMATION - continued

Persistence and Degradability: Readily Biodegradable per OCED 301D, Closed Bottle Test. Reaches 100% biodegradation within 60 days.
Bioaccumulative Potential: No data available.
Mobility in Soil: No data available.
Other Adverse Effects: No data available.

Section 13: DISPOSAL CONSIDERATIONS

Unused or Used Liquid: May be considered hazardous in your area depending on usage and tonnage of disposal – check with local, regional, and or national regulations for appropriate methods of disposal.

Empty Containers: May be offered for recycling.

Never dispose of used degreasing rinsates into lakes, streams, and open bodies of water or storm drains.

Section 14: TRANSPORT INFORMATION

U.N. Number: Not applicable
U.N. Proper Shipping Name: Cleaning Compound, Liquid NOI
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Marine Pollutant - NO
Transport in Bulk (according to Annex II of MARPOL 73/78 and IBC Code): Unknown.
Special precautions which user needs to be aware of/comply with, in connection with transport or conveyance either within or outside their premises: None known.

U.S. (DOT) / Canadian TDG: Not Regulated for shipping.
IMO / IDMG: Not classified as Hazardous
ICAO/ IATA: Not classified as Hazardous
ADR/RID: Not classified as Hazardous

Section 15: REGULATORY INFORMATION

All components are listed on: TSCA and DSL Inventory.

SARA Title III: Sections 311/312 Hazard Categories – Not applicable.
Sections 313 Superfunds Amendments and Reauthorizations Act of 1986 – Not applicable.
Sections 302 – Not applicable.

Clean Air Act (CAA): Not applicable
Clean Water Act (CWA): Not applicable

State Right To Know Lists: No ingredients listed
California Proposition 65: No ingredients listed

This product has been classified as “not classifiable as hazardous” in accordance with Consumer Product Safety Commission (16 CFR Chapter 2) and labelled and packaged accordingly.

US Consumer Product Safety Commission Regulations
This product is labeled in accordance with regulations administered by the Consumer Product Safety Commission (CPSC). However, the use pattern and exposure in the workplace are generally not consistent with those experienced by consumers. Therefore, the requirements of the Occupational Safety and Health Administration applicable to this SDS differ from the labeling requirements of the CPSC, and this SDS may contain additional health hazard information not pertinent to consumer use and not found on the product label.

Section 16: OTHER INFORMATION

Size	UPC	Size	UPC
2 fl. oz.	043318131035	67.6 fl. oz.	043318000393
4 fl. oz.	043318130014	67.6 fl. oz.w/ dilution bottle	043318005442
16 fl. oz.	043318130021	140 fl. oz.	043318001390
22 fl. oz.	043318130229	140 fl. oz. w/ dilution bottle	043318001468
24 fl. oz.	043318006241	1 gallon	043318000799
24 fl. oz.	043318130137	1 gallon	043318004957
32 fl. oz.	043318000652	1 gallon	043318130052
32 fl. oz.	043318002557	1 gallon w/ dilution bottle	043318480416
32 fl. oz.	043318130335	1 gallon w/ dilution bottle	043318480492
67.6 fl. oz.	043318130144	2.5 gallon	043318004889

USA items listed only. Not all items listed. USA items may not be valid for international sale.

NFPA:
Health – None
Flammability – Non-flammable
Stability – Stable
Special - None



Acronyms

NTP	National Toxicology Program	IARC	International Agency for Research on Cancer
OSHA	Occupational Safety and Health Administration	CPSC	Consumer Product Safety Commission
TSCA	Toxic Substances Control Act	DSL	Domestic Substances List

Prepared / Revised By: Sunshine Makers, Inc., Regulatory Department.
This SDS has been revised in the following sections: Aligned Section 3 with California Ingredient Disclosure and minor fixes.

DISCLAIMER: The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

APPENDIX E

DAILY TAILGATE SAFETY MEETING FORM

DAILY TAILGATE SAFETY MEETING

NOTE: A new tailgate meeting must be conducted if conditions, location, or personnel change.

Date: _____ Time: _____ ☐ a.m. ☐ p.m. Location: _____(city, state)

Project Name: _____ Client: _____

Current Objective/Description: _____

_____

See it! Identify Current Objective Hazards:

Assess Trihydro's 3 Most Serious Risks

- ☐ Traffic/Heavy Equipment
- ☐ Hazardous Atmosphere
- ☐ Utility Contact

Assess Trihydro's 5 Most Frequent Risks

- ☐ Hand Injuries
- ☐ Lifting
- ☐ Biological Hazards
- ☐ Chemical Exposure
- ☐ Slips, trips, falls

Other Hazards

- ☐ Weather
- ☐ Working at Heights

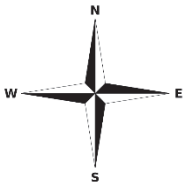
Additional Identified Hazards:

- ☐ Abrasions, cuts, scrapes
- ☐ Allergies (self & co-workers)
- ☐ Asbestos
- ☐ Burn hazards
- ☐ Compressed gases
- ☐ Confined space
- ☐ Drilling/Excavation
- ☐ Electrical
- ☐ Ergonomic
- ☐ Flammable gas/vapor
- ☐ H_2S
- ☐ High-pressure processes
- ☐ Noise
- ☐ Other contractors
- ☐ Overexertion
- ☐ Particulates (silica, dust, smoke)
- ☐ Pinch points
- ☐ Power tools
- ☐ Pulled into / Rotating
- ☐ Radiation/X-ray
- ☐ Scaffolds / Ladders
- ☐ Struck by (falling objects, swinging equip)
- ☐ Utilities – overhead/subsurface
- ☐ Water
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Weather Hazards:

- ☐ Cold stress
- ☐ Heat stress
- ☐ High wind
- ☐ Lightning
- ☐ Snow/Ice
- ☐ Severe weather

Indicate wind direction



Additional Notes:

_____

_____

_____

_____

_____

_____

Personal Protective Equipment (PPE):

- ☐ Hard hat
- ☐ Safety glasses
- ☐ Safety toed boots
- ☐ Appropriate gloves
- ☐ High visibility vest
- ☐ Hearing protection
- ☐ Long sleeves
- ☐ Face shield/goggles
- ☐ FRCs
- ☐ Sunscreen (as needed)
- ☐ Fall protection
- ☐ H_2S monitor
- ☐ 4-gas Meter
- ☐ Dust mask
- ☐ Respirator
  - ☐ Half ☐ Full
- ☐ Tyvek®
- ☐ Rain gear / rubber boots
- ☐ Snake chaps
- ☐ Insect repellant
  Do **not apply DEET to FRCs**

Other special equipment:

- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Before Beginning Work:

- ☐ Sign in and out of process unit ☐ N/A
- ☐ HASP reviewed & acknowledged
- ☐ Locate the nearest evacuation point and a secondary location
- ☐ If lone worker, implement lone worker procedures ☐ N/A
- ☐ Identify CPR/AED/first aid certified employees
- ☐ Identify the nearest fire extinguisher, eyewash station, first aid kit, and Safety Data Sheets (SDSs)
- ☐ Identify SSE, visitor(s), or guest(s) ☐ N/A
- ☐ Barricade work zone (as needed)
- ☐ Review the JSA and "dirty up"
- ☐ Personal monitoring equipment calibrated per manufacturer
- ☐ Perform a Work-Site Self-Assessment (WSSA)
- ☐ Determine, acquire, and post necessary permits ☐ N/A
  Permit required: _____

Safe Vehicle Use:

- ☐ Pre-inspection complete
- ☐ Emergency brake/chocks (if required)
- ☐ Keys left in vehicle (if required)
- ☐ Trailer Safety Inspection form (if needed)
- ☐ No cell phones used while driving
- ☐ Park in a safe location
- ☐ Orange cone used (if required)
- ☐ Site-Specific:_____
- ☐ Get Out And Look (GOAL)
- ☐ Spotter used (if available)
- ☐ Load secured in vehicle
- ☐ Other: _____

Additional Comments: _____

_____

_____

_____

Printed Name	Signature	Company	Is this worker new on-site?
1.			☐ Yes ☐ No
2.			☐ Yes ☐ No
3.			☐ Yes ☐ No
4.			☐ Yes ☐ No
5.			☐ Yes ☐ No
6.			☐ Yes ☐ No
7.			☐ Yes ☐ No
8.			☐ Yes ☐ No
9.			☐ Yes ☐ No
10.			☐ Yes ☐ No

* Identify the site safety officer with an asterisk (*) next to their printed name.

APPENDIX F

WORK-AREA EVALUATION FOR CONFINED SPACES

WORK-AREA EVALUATION FOR CONFINED SPACES

Trihydro

Note: Confined-space entry must be reviewed by the Business Unit Leader and Health and Safety Manager before work begins.

Date: _____ Project Site: _____

Client: _____ Project Number: _____

SECTION 1: CONFINED SPACE (CS) EVALUATION			TRUE	FALSE
1.	Size	Is the space large enough and so configured that an employee can bodily enter and perform assigned work?	☐	☐
2.	Access/Egress	Are there limited or restricted means of access or egress?	☐	☐
3.	Occupancy	The space is ***not*** designed for continuous human occupancy.	☐	☐

If ***all three*** answers are **"TRUE,"** this is considered a confined space; continue with Sections 2 and 3.

If at least one answer is **"FALSE,"** this is considered a non-regulated space; continue to Section 3.

SECTION 2: PERMIT-REQUIRED CONFINED SPACE (PRCS) EVALUATION			YES	NO
4.	Hazard	A. Is there a potential for or an actual hazardous atmosphere?	☐	☐
		If yes, explain: _____		
		B. Is there a potential for engulfment or entrapment?	☐	☐
		If yes, explain: _____		
		C. Is the internal configuration such that an entrant may be trapped or asphyxiated?	☐	☐
		If yes, explain: _____		
		D. Does the work space contain any other safety or health hazard (e.g., mechanical, chemical, thermal, electrical, etc.)?	☐	☐
		If yes, identify: _____		
		E. Is the work space identified as a permit-required confined space by the client (warning sign, location map, etc.)?	☐	☐*

*If "NO," consider contacting the client and advising them of the unidentified permit-required confined space.

SECTION 3: SPACE DESIGNATION

Based on the answers to the above questions, designate the type of confined space identified:

☐ The work area has been evaluated for confined spaces; none were identified.

☐ The work area has been evaluated for confined spaces; the following confined space(s) was identified:

Confined Space Location: _____ Identification: _____

Confined Space Description: _____

The space is designated:

1. ☐ Non-permit required ("FALSE" was checked for one or more question in Section 1)
2. ☐ Confined space, no permit required ("TRUE" was checked for ***all*** questions in Section 1)
3. ☐ Permit-required confined space ("TRUE" was checked for ***all*** questions in Section 1 ***and*** "YES" was checked for at least one question in Section 2)

Evaluation performed by: _____ _____

Print Full Name ***Signature***

Instructions

Work-Area Evaluation for Confined Spaces

The project team must evaluate each work area to determine if confined spaces are present.

Section 1: Confined Space Evaluation

If the project team identifies a space that is classified as a confined space, they are to designate which type and communicate the evaluation to the project manager (PM).

To classify a space as a *confined space*, ***all three*** of the following criteria must be met:

Size: Is the space large enough and so configured that an employee can bodily enter and perform assigned work?

Access/Egress: Are there limited or restricted means of access or egress? Can the employee easily egress (exit) the space if there is an emergency? Can rescue personnel easily enter the space?

Occupancy: Is the space ***not*** designed for continuous human occupancy? Is the space only designed to house equipment? Are there normal-sized doorways and windows?

If the space is classified as a *confined space*, the next step is to evaluate it as a *permit-required confined space*.

Section 2: Permit-Required Confined Space Evaluation

To classify a *confined space* as a *permit-required confined space*, ***any*** of the following criteria must be met:

1. Contains or has a potential to contain a hazardous atmosphere:
    A. Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);
    B. Airborne combustible dust at a concentration that meets or exceeds its LFL;

       NOTE: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet or less.
    C. Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
    D. Atmospheric concentration of any toxic substance above its permissible exposure limit (PEL); or
    E. Any other atmospheric condition that is immediately dangerous to life or health.
2. Contains a material that has the potential for engulfing an entrant;
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section; or
4. Contains any other recognized serious safety or health hazard.

Section 2: Space Designation

If there are no confined spaces identified in the work area, check the box indicating so and file the form.

If there are confined spaces identified in the work area:

1. Check the box indicating so.
2. Give the location, identification, and a description of the confined space (e.g., tank farm 1, MW-01, monitoring well vault).
3. Designate if the space is a non-permit required confined space, confined space, or permit-required confined space.
4. Communicate the evaluation to the PM and project-team members.
5. File the form in the project filing system.

APPENDIX G

UTILITIES LOCATE ACKNOWLEDGEMENT

UTILITIES LOCATE ACKNOWLEDGEMENT

Trihydro

Utilities Locate Area Map



By signing below, I verify that I have located and marked the specified utilities within the boundaries of the project site as indicated on the map above.

Utility Located: ☐ Gas ☐ Electric ☐ Sewer ☐ Communication ☐ Water ☐ Other: _____

Company | Name | Signature | Date

Utility Located: ☐ Gas ☐ Electric ☐ Sewer ☐ Communication ☐ Water ☐ Other: _____

Company | Name | Signature | Date

Utility Located: ☐ Gas ☐ Electric ☐ Sewer ☐ Communication ☐ Water ☐ Other: _____

Company | Name | Signature | Date

Utility Located: ☐ Gas ☐ Electric ☐ Sewer ☐ Communication ☐ Water ☐ Other: _____

Company | Name | Signature | Date

Utility Located: ☐ Gas ☐ Electric ☐ Sewer ☐ Communication ☐ Water ☐ Other: _____

Company | Name | Signature | Date

APPENDIX H

EXPOSURE INCIDENT REPORT

EXPOSURE INCIDENT REPORT

Trihydro

EXPOSED INDIVIDUAL: **Name:** _____

Address: _____

Route(s) of exposure: ☐ **Eye** ☐ **Mouth** ☐ **Mucous membrane**

(check any that apply) ☐ **Non-intact skin** ☐ **Puncture**

To what was the employee exposed? ☐ **Blood** ☐ **Vomit** ☐ **Feces**

☐ **Urine** ☐ **Other** **(describe below)**

Describe the exposure incident on the attached DJJ incident report. Include description of:

- **What work was being done**
- **What caused the incident**
- **What personal protective equipment was worn**
- **What action was taken following the incident**

SOURCE INDIVIDUAL: **Name:** _____

Address: _____

Does your state have a confidentiality requirement? ☐ **Yes** ☐ **No** ☐ **Unknown**

Is the source individual infected with HBV or HIV? ☐ **Yes** ☐ **No** ☐ **Unknown**

Has the source individual consented to blood testing? ☐ **Yes** ☐ **No**

MEDICAL EXAMINATION CHECKLIST:

Provide the following to the doctor performing follow-up medical evaluation:

- **Copy of bloodborne pathogens standard (29 CFR 1910.1030)**
- **Copy of this report**
- **Results of source individual's blood tests**
- **Copy of the exposed employee's medical records relevant to the exposure**

Completed by: _____ **Date:** _____

Continued on back

EXPOSED EMPLOYEE MEDICAL RELEASE:

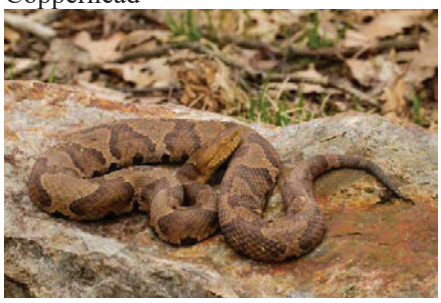
I AFFIRM THAT THE INFORMATION IN THIS REPORT IS CORRECT, AND AUTHORIZE MY EMPLOYER TO RELEASE ALL RELEVANT MEDICAL RECORDS TO THE HEALTH CARE PROVIDER WHO WILL PERFORM THE MEDICAL EVALUATION AND FOLLOW-UP FOR THIS EXPOSURE INCIDENT. I UNDERSTAND THAT ALL INFORMATION COLLECTED DURING THIS EVALUATION AND THE CONTENTS OF THIS REPORT WILL REMAIN CONFIDENTIAL.

Employee signature _____ **Date:** _____

APPENDIX I

POISONOUS SNAKES ASSOCIATED BY STATE

Poisonous Snakes Associated by State

State		State	
Copperhead 	AL, AR, CT, DE, FL, GA, IL, IN, KS, KY, LA, MA, MS, MO, NE, NJ, NY, NV, OH, OK, PA, RI, SC, TN, TX, VA, WV	Desert Mississauga Rattlesnake 	AZ, CO, NM, TX
Eastern Mississauga Rattlesnake 	IL, IN, IA, MI, MN, MO, NY, OH, PA, WI	Great Basin Rattlesnake 	AZ, CA, ID, NV, OR, UT
Mojave Rattlesnake 	AZ, CA, NM, NV, TX, UT	Prairie Rattlesnake 	AZ, CO, ID, IA, KS, MT, NE, ND, NM, OK, SD, TX, UT, WY
Sidewinder 	AZ, CA, NV, UT	Speckled Rattlesnake 	AZ, CA, NV, UT

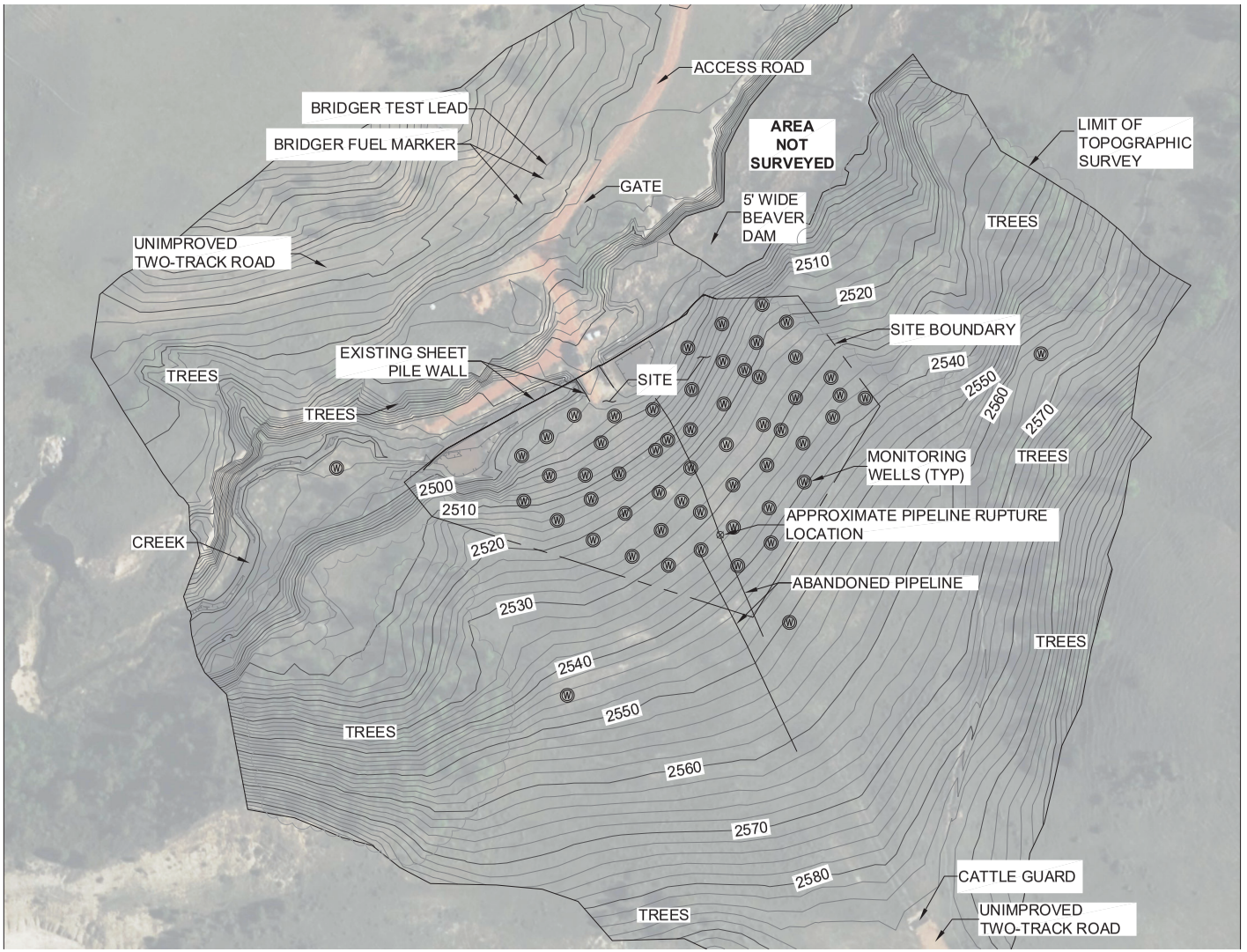
Poisonous Snakes Associated by State

State	State
Western Rattlesnake  AZ, CA, CO, ID, NV, OR, UT, WA	

APPENDIX B

MAP OF THE ASH COULEE CREEK REMEDIATION SITE

United States, et al. v. Belle Fourche Pipeline Company



0 50 100 200

SCALE IN FEET

		ASH COULEE INCIDENT	SITE MAP
			June 2026 **FIGURE 1**

P:\22148 - ASH COULEE INCIDENT S-316.3\CAD\WORKING\22148_29-6-16_BASEMAP.DWG 6/18/2026 8:58 AM

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APPENDIX C

ENVIRONMENTAL COVENANT

United States, et al. v. Belle Fourche Pipeline Company

APPENDIX C

NDDEQ Institutional Control Document Number: EC 2026000002

ENVIRONMENTAL COVENANT

United States, et al. v. Belle Fourche Pipeline Company

This instrument is an Environmental Covenant executed pursuant to the North Dakota Uniform Environmental Covenants Act, N.D.C.C. Ch. 47-37 (the "Act"). This Environmental Covenant is entered into by the entities and individuals executing this Environmental Covenant and subjects the property identified below to the activity and use limitations and other requirements. This Environmental Covenant further grants such other rights in favor of the North Dakota Department of Environmental Quality ("NDDEQ") and the Environmental Protection Agency ("EPA") as set forth herein.

1. **Property Description.** A complete legal description of the Property is attached to this Environmental Covenant as **Exhibit A**. The legal description was prepared by KLJ Engineering, 677 27th Avenue East, Dickinson, ND 58601. A map of the Property is attached to this Environmental Covenant as **Exhibit B**.

2. **Owner/Grantor.** This Property is owned by Egly Family LLLP (Owner). The sole general partner and representative of Owner is Sonny Egly, 13580 21st Street NW, Belfield, ND 58662. The Owner is the Grantor of this Environmental Covenant.

3. **Agency.** The Agency, as defined by N.D.C.C. § 47-37-01(2), is NDDEQ and EPA.

4. **Holder/Grantee.** The Grantee and Holder, as defined by N.D.C.C. § 47-37-01(6), of this Environmental Covenant is NDDEQ.

5. **Running with the Land.** This Environmental Covenant shall be binding upon the Owner and upon all assigns and successors in interest, including any Transferee, and shall run with the land, pursuant to N.D.C.C. § 47-37-04(1), subject to amendment or termination as set forth herein. The term "Transferee", as used in this Environmental Covenant, shall mean any future owner of any interest in the Property or any portion thereof, including, but not limited to, owners of an interest in fee simple, mortgagees, easement holders, and lessees.

6. **Background.** The Property is the subject of an environmental response project pursuant to a Supplemental Consent Decree in *United States et al. v. Belle Fourche Pipeline*, No. 22-00089-DLH-CRH, which arose out of a claim under N.D.C.C. ch. 61-28, among other claims. The environmental response project is set forth in the Remediation Work Plan attached as Appendix A to the Supplemental Consent Decree ("Work Plan"). The Owner, NDDEQ, and EPA have determined that an Environmental Covenant is appropriate for the

Property because of the presence and potential exposure to residual contamination from hydrocarbons from a crude oil spill.

7. **Administrative Record.** Subject to NDDEQ's record retention policy, the administrative record for this project is available to the public and located at NDDEQ's Bismarck, North Dakota Office, in the file maintained for EC2026000002.

8. **Representation and Warranties.** The Owner hereby represents and warrants to NDDEQ and any other signatories to this Environmental Covenant that, at the time of the execution of this Environmental Covenant:

   a. The Owner is the sole fee title owner of the Property;
   b. The Owner has the authority to grant the rights and interests and carry out the obligations provided in this Environmental Covenant;
   c. Nothing in this Environmental Covenant materially violates, contravenes, or constitutes a default under any agreement, document, or instrument that is binding on the Owner;
   d. This Environmental Covenant does not violate any local or county zoning or land use laws.

9. **Activity and Use Limitations.** The Owner hereby imposes and agrees to comply with the following activity and use limitations on the Property:

   a. The Owner shall not engage in any activity on the Property that may interfere with the implementation, operation, or maintenance of the activities required in the Work Plan;
   b. The Property shall not be used for any residential use, including single family homes; and
   c. The drilling of wells for domestic or livestock use is prohibited.

10. **Rights of Access.** In addition to any rights already possessed, this Environmental Covenant grants to authorized representatives of NDDEQ, EPA, and representatives of Belle Fourche Pipeline Company a right of reasonable access of the Property in connection with implementation or enforcement of this Environmental Covenant, including the right to take samples of environmental media and install and maintain structures necessary to carry out the sampling.

11. **Notification of Violation.** If the Owner or any Transferee, as applicable, becomes aware of any event or action that causes a breach or violation of the Activity and Use Limitations, the Owner or Transferee, as applicable, must notify NDDEQ as soon as possible and in no event later than thirty (30) days after becoming aware of the event or action that caused the breach or violation.

12. **Enforcement.** This Environmental Covenant may be enforced as provided in N.D.C.C. § 47-37-10. Nothing in this instrument restricts NDDEQ and any other Agency from exercising any authority under applicable law.

13. **Notice in Subsequent Instruments of Conveyance.** Owner agrees that each instrument hereafter conveying any interest in the Property, or any portion of the Property, must contain a notice of the Activity and Use Limitations identified in paragraph 9, above, and provide the recorded location of this instrument with the Billings County Recorder, including the appropriate document number, book, or page where this instrument is recorded. The Owner or Transferee conveying the interest must notify NDDEQ in writing within ten (10) days after each conveyance of an interest in any portion of the Property. The notice must include the new owner's name, address, and telephone number; a copy of the deed or other documentation evidencing the conveyance; where the conveyance is recorded; and, if the conveyance is of, or affects, less than all of the Property, a survey map that shows the boundaries of the property conveyed or affected.

14. **Amendment or Termination.** This Environmental Covenant may be amended or terminated as provided in the Act.

15. **Severability.** If any provision of this Environmental Covenant is found to be unenforceable in any respect, the validity, legality, and enforceability of the remaining provisions shall not in any way be affected or impaired.

16. **Governing Law.** This Environmental Covenant shall be governed by and interpreted in accordance with the laws of the State of North Dakota.

17. **Recording and Notice of Environmental Covenant.** The Owner shall file this Environmental Covenant with the Billings County Recorder within thirty (30) days after this instrument is executed. NDDEQ may cancel or revoke this Environmental Covenant if Grantor fails to record it with the county recorder. Within thirty (30) days after it is recorded, the Owner shall distribute a copy of this Environmental Covenant in recorded form to:

    a. Each person that signed the covenant or their successor or assign;
    b. Each person holding a recorded interest in the Property;
    c. Each person in possession of the Property;
    d. Each municipality or unit of local government in which the Property is located.

18. **Submission of Required Documents and Communications.** Unless otherwise notified in writing, documents and communications required by this Environmental Covenant shall be submitted to:

    North Dakota Department of Environmental Quality
    Office of the Director
    EC2026000002

    4201 Normandy St., Bismarck, North Dakota 5850-1324.

19. **Effective Date.** The effective date of this Environmental Covenant shall be the date upon which the fully executed Environmental Covenant has been recorded with the county recorder.

[*Signature Pages and Exhibits Follow*]

SIGNATURE PAGE
TO
ENVIRONMENTAL COVENANT

It is so agreed:

Egly Family LLLP

Sonny Egly, Edwin Egly
Sonny Egly,
as, General Partner

6-1-26
Date

State of North Dakota)
) ss.
County of Bowman)

On this 1st day of June, 2026, before me personally appeared Edwin J. Egly, known to me to be the general partner of Egly Family, LLLP, a North Dakota limited liability limited partnership, and known to me to be the person described in and who executed the within instrument and acknowledged to me that he executed the same as such Sole General Partner of the corporation.

KATHERINE F COX
Notary Public
State of North Dakota
My Commission Expires May 9, 2028

Katherine F Cox
Notary Public

My Commission Expires: May 9, 2028

SIGNATURE PAGE
TO
ENVIRONMENTAL COVENANT

It is so agreed:

NORTH DAKOTA DEPARTMENT OF ENVIRONMENTAL QUALITY

L. David Glatt, P.E., Director
Department of Environmental Quality

Date 6-22-2026

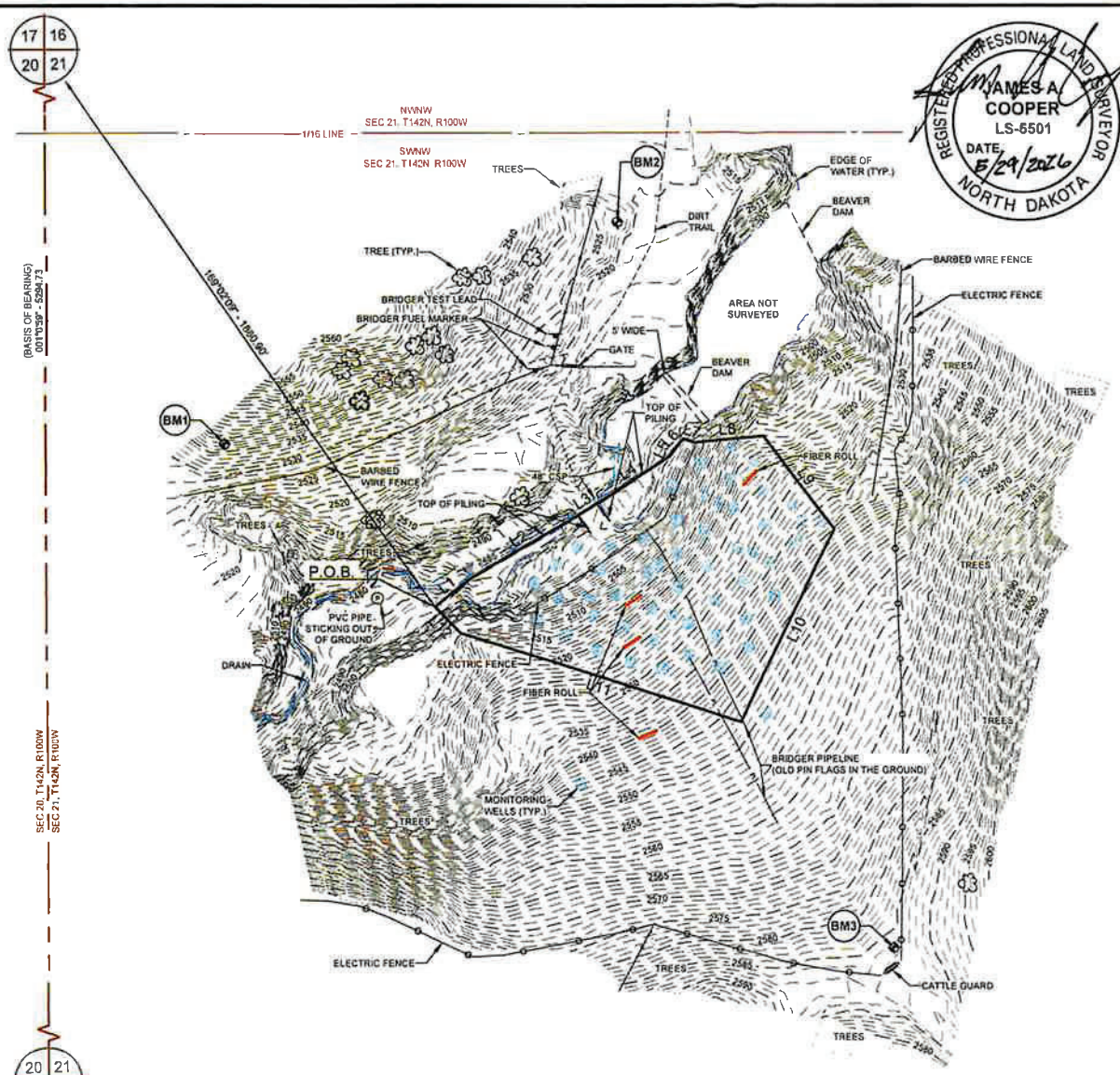
State of North Dakota)
) ss.
County of Burleigh)

On this 22 day of June, 2026, before me personally appeared L. David Glatt, P.E., Director of the North Dakota Department of Environmental Quality, known to me to be the person described in and who executed the within instrument and acknowledged to me that he executed the same on behalf of the North Dakota Department of Environmental Quality.

ELIZABETH JACOBSON
Notary Public
State of North Dakota
My Commission Expires Oct 16, 2027

Notary Public

My Commission Expires: —



I, James A. Cooper, a Professional Land Surveyor, N.D. PLS No. 5501, do hereby certify that the survey plat shown hereon was made by me, or under my direction, from notes made in the field, and the same is true and correct to the best of my knowledge and belief. The field survey was performed by Derek Urayon February 10, 2026.

REGISTERED PROFESSIONAL LAND SURVEYOR
JAMES A. COOPER
LS-6501
DATE 2/29/2026
NORTH DAKOTA

James A. Cooper, Professional Land Surveyor
N.D. PLS No. 5501

NOTE:
1. SURVEY IS BASED ON NORTH DAKOTA STATE PLANE, NAVD83, SOUTH ZONE, U.S. FOOT. AZIMUTHS SHOWN ARE GRID AZIMUTHS, DISTANCES SHOWN ARE GRID DISTANCES. MULTIPLY BY 1.000053002 TO GO FROM GRID DISTANCE TO GROUND DISTANCE.

N

60 0 60 120
scale 1" = 120' feet

BENCHMARK				
#	NORTHING	EASTING	ELEVATION	DESCRIPTION
BM1	537,890.341	1,253,816.035	2,537.84	5/8 X 18' REBAR
BM2	538,112.005	1,254,246.867	2,523.39	5/8 X 18" REBAR
BM3	537,322.622	1,254,513.016	2,586.39	5/8 X 18" REBAR

TOPO LEGEND

EXISTING	ITEM	PROPOSED/ FUTURE
	1' INTERMEDIATE CONTOUR	N/A
	5' INDEX CONTOUR	N/A
	SECTION LINE	N/A
	1/4 & 1/16 LINES	N/A
	CULVERT	N/A
	TREE ROWS, BUSHES	N/A
PL	PIPELINE	N/A
X	BARBED WIRE FENCE	N/A
O	ELECTRIC FENCE	N/A
	DRAINAGE/EDGE OF WATER	N/A
	TOP OF PILING	N/A
	FIBER ROLL	N/A
	MONITORING WELLS	N/A
P	PVC PIPE	N/A
	FUEL MARKER	N/A
	TREE	N/A

May 29, 2026 - 7:52 AM - K:\Projects\ProfServices\RJH Consultants\2024-10089\CAD\Addutsi\2024-10089_Metes & Bounds.dwg
© KLJ ENGINEERING LLC 2026

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LINE	DIRECTION	DISTANCE
L1	053°06'57"	48.27'
L2	061°31'46"	135.01'
L3	060°26'05"	24.64'
L4	059°28'46"	93.02'
L5	027°51'25"	5.91'
L6	044°51'01"	17.98'
L7	109°37'29"	12.56'
L8	086°49'12"	75.02'
L9	144°51'22"	125.38'
L10	207°57'47"	232.18'
L11	289°48'44"	316.20'
L12	317°57'06"	40.10'

A portion of land located in the Southwest Quarter of the Northwest Quarter of Section 21, Township 142 North, Range 100 West of the 5th Principal Meridian, Billings County, North Dakota, more particularly described as follows:

Commencing at the northwest corner of said Section 21 thence on an azimuth of 169°02'09", a distance of 1880.90 feet to the POINT OF BEGINNING; thence on an azimuth of 053°06'57", a distance of 48.27 feet; thence on an azimuth of 061°31'46", a distance of 135.01 feet; thence on an azimuth of 060°26'05", a distance of 24.64 feet; thence on an azimuth of 059°28'46", a distance of 93.02 feet; thence on an azimuth of 027°51'25", a distance of 5.91 feet; thence on an azimuth of 044°51'01", a distance of 17.98 feet; thence on an azimuth of 109°37'29", a distance of 12.56 feet; thence on an azimuth of 086°49'12", a distance of 75.02 feet; thence on an azimuth of 144°51'22", a distance of 125.38 feet; thence on an azimuth of 207°57'47", a distance of 232.18 feet; thence on an azimuth of 289°48'44", a distance of 316.20 feet; thence on an azimuth of 317°57'06", a distance of 40.10 feet to the POINT OF BEGINNING.

Said portion of land contains 1.72 acres, more or less.

REGISTERED PROFESSIONAL LAND SURVEYOR
JAMES A. COOPER
LS-5501
DATE 5/29/2026
NORTH DAKOTA

I, James A. Cooper, a Professional Land Surveyor, N.D. PLS No. 5501, do hereby certify that the survey plat shown hereon was made by me or under my direction, from notes made in the field, and the same is true and correct to the best of my knowledge and belief. The field survey was performed by Derek Urso on February 10, 2026.

James A. Cooper, Professional Land Surveyor
N.D. PLS No. 5501

May 29, 2026 - 7:52 AM - E:\Projects\ProjServices\KLJH Consultants\2824-10089-CAD\Asbuilts\2824-10089_Metes & Bounds.dwg

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APPENDIX D

MONITORING WORK PLAN

United States, et al. v. Belle Fourche Pipeline Company

July 1, 2026

Remedy Monitoring Plan

Belle Fourche Pipeline Company
Ash Coulee
Billings County, North Dakota

Prepared For:

Trihydro Corporation
1252 Commerce Drive, Laramie, WY 82070

Project Number BELLE-026-0001

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People you can trust.

www.trihydro.com

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C. NSZD Data Collection Standard Operating Procedures

1.0 Introduction

Trihydro Corporation (Trihydro), on behalf of Belle Fourche Pipeline Company (BFPC), has prepared this Remedy Monitoring Plan (Plan) detailing monitoring activities to be implemented post-remedy construction at the Ash Coulee crude pipeline release (Site).

1.1 Planned Remedy Construction

The planned 2026 remedial activities are set forth in the NDDEQ-approved *Work Plan for Final Remedial Action at the Belle Fourche Pipeline Company Crude Oil Spill Site Near Belfield, North Dakota* (Geomega 2025). Remedy construction is anticipated to be completed in summer/fall 2026, with completion by the end of November 2026.

2.0 Monitoring

2.1 Tributary Monitoring

Monthly monitoring of Ash Coulee Tributary will be performed in accordance with the Surface Water Sampling Standard Operating Procedure (SOP) provided in Appendix A. Surface water sampling locations include one upstream and two downstream of the release. Monthly surface water monitoring includes measuring field parameters and sample collection for laboratory analysis. Monthly stream sampling reports will be submitted to NDDEQ.

2.2 Fluid Level Gauging

Fifty-six wells were installed in 2017 as part of the initial remedial effort designed to inject hydrogen peroxide, extract hydrocarbon vapors, and introduce atmospheric air to the subsurface. This includes nine 2-inch and four 1-inch injection wells (HP-number), thirteen 2-inch vapor extraction wells (V-number), and thirty 1-inch air entry wells (AE-number). Table 2-1 includes well completion details and Figure 1-1 shows well locations. Accessible wells have been gauged since fall 2017 during the active field season (typically May to October). Table 2-2 lists the most recent May 2026 gauging event data, including blocked wells. A blocked well designation indicates the interface probe could not be lowered to the documented total well depth. Additionally, wells HP-05 b, c, and d have not been gauged since May 2019 due to safety concerns accessing these locations, which are fully or partially submerged in water from a beaver dam. A blocked or inaccessible well will not be gauged.

During the remedy construction activities planned for summer/fall 2026, some number of wells will be abandoned due to working area limitations and remedy implementation plans. The wells will be abandoned by filling the well with bentonite. The Remedy Construction Report will list which wells were abandoned and evaluate the usefulness of that well location. The Remedy Construction Report may provide a recommendation for potential well replacements based on well location, historical fluid levels, and LNAPL recovery.

Fluid level gauging will be performed at a minimum twice per field season, once at the beginning (typically May) and once at the end (typically September). The measurements will be gauged to the nearest 0.01-foot using an oil/water interface probe and include depth to LNAPL and groundwater, if present, and total depth of well if neither LNAPL nor groundwater are present. Total well depths where fluids are measured will be collected on an as needed basis, typically every few years to record blocking and/or silting. Portions of the interface probe that come into contact with the well and/or groundwater will be decontaminated prior to use at each well using a non-phosphate based detergent and distilled water. Fluid levels and observations will be recorded on the field forms contained in Appendix B. Fluid levels will be used to calculate LNAPL thickness and groundwater and LNAPL elevations over time.

2.3 LNAPL Removal

LNAPL will be recovered as needed during the field season, limited to late spring through early fall due to safety concerns regarding winter conditions (e.g., snow, ice, cold temperatures). Recovery will be performed at select wells with the assistance of a vacuum truck contractor. LNAPL was previously recovered from the two collection ponds behind the sheet pilings. 2021 was the last year there was sufficient volume of LNAPL to recover from the ponds. Additionally, the planned remedy construction includes removal of impacted soil in the Lowland Area, installation of a fluid collection system, and backfilling with clean material so there is positive drainage towards the creek. Therefore, future monitoring and LNAPL recovery at the collection ponds is not a component of the Plan.

LNAPL will be recovered from select wells using a ½-inch downhole suction tube referred to as a "stinger" and suction provided from a vacuum truck. Fluid level gauging and recovery data from each prior event will be used to optimize the next recovery event in order to maximize the volume recovered relative to the level of effort. LNAPL may also be recovered using vacuum-enhanced fluid extraction (VFE), which works by applying a vacuum on the well to induce removal of LNAPL, water, and vapors. Previously VFE has been used at two wells with higher levels of recovery to enhance overall recovery efforts. The use of VFE will be evaluated on a yearly basis to determine the need for this recovery method. LNAPL recovery from wells will continue until there is no longer measurable and recoverable LNAPL present.

2.4 Carbon Dioxide Efflux Monitoring

Natural Source Zone Depletion (NSZD) measurements will be collected in accordance with previous collection methods. Soil collars will be placed at 28 locations within the footprint of subsurface LNAPL impacts and at 12 locations in unimpacted areas to assess background conditions. Locations and well numbers may be modified based on remedy construction. Measurements of carbon dioxide (CO_2) efflux will be made with a LI-COR Biosciences dynamic closed chamber. Figure 2-1 shows previously used and proposed CO_2 efflux measurement locations. CO_2 efflux measurements will be collected annually towards the end of the field season when the slope is dry and before cold weather sets in (typically late August or early September). The collars will be placed in accordance with SOP provided in Appendix C. Repeated measurements will be collected at locations, one in the morning and the other in the afternoon, to account for daily fluctuations. Efflux data collection will be performed in accordance with the SOP in Appendix C. CO_2 efflux measurements will be recorded on a field form provided in Appendix C. The average of the two CO_2 efflux values will be used for data evaluation.

The unimpacted CO_2 efflux measurements will be used for background correction. The net CO_2 efflux in LNAPL impacted areas (i.e., the difference between average CO_2 efflux values above impacted and unimpacted areas) will be used to estimate the rate at which LNAPL is being degraded by biological processes. Calculations will assume

a 60,000 square foot (1.4 acre) area over which NSZD is occurring; however, this area may be refined as the impacted footprint decreases over time. Past NSZD data evaluation has shown NSZD processes are degrading LNAPL, with a peak degradation rate in 2021. The current decreasing trend is anticipated to continue due to the decreasing amount of LNAPL available for degradation over time.

2.5 Collection Vault Monitoring and Cleanout

The fluid collection system will include a buried collection vault and perforated collection pipes that will be located at the toe of the slope, as described in the Work Plan and construction documents. The vault will be regularly monitored, and the collected fluids will be removed for proper disposal as needed. The Remedy Construction Report will include as-built design of the collection vault and other relevant information regarding the fluid collection system.

2.6 Site Maintenance

The Site will be monitored at least semi-annually for vegetation growth, erosion, and other issues that require repair. Additionally, the remediation wells, run-off controls, fluid collection system, and riprap flood protection will be inspected at least semi-annually, and necessary repairs will be performed.

3.0 Reporting and Schedule

3.1 Data Evaluation and Reporting

Annual reports will be submitted to NDDEQ documenting monitoring and remedial activities completed during the year and will include recommendations for the upcoming year.

3.2 Schedule

This Plan will be implemented in 2027, upon completion of the remedy construction activities, anticipated by the end of November 2026.

4.0 References

Geomega. 2025. Work Plan for the Final Remedial Action at the Belle Fourche Pipeline Company Crude Oil Spill Site Near Belfield, North Dakota. March 7.

Tables

TABLE 2-1. WELL CONSTRUCTION SUMMARY
ASH COULEE INCIDENT S316.2
BILLINGS COUNTY, NORTH DAKOTA

Well ID	Ground Elevation (ft MSL)	Casing Diameter (in)	Total Depth (ft btoc)	Total Depth Elevation (ft MSL)	Casing Stickup (ft)
V-01	2497	2	18.50	2483	4.58
V-02	2516	2	23.10	2497	3.95
V-03	2495	2	18.60	2481	4.28
V-04	2500	2	18.10	2486	4.28
V-05	2516	2	28.10	2492	4.57
V-06	2528	2	28.31	2504	4.39
V-08	2502	2	28.19	2478	4.65
V-09	2510	2	26.50	2488	4.50
V-10	2521	2	20.35	2505	4.51
V-11	2530	2	33.10	2501	4.08
V-12	2520	2	27.95	2496	4.18
V-13	2525	2	28.23	2501	4.66
V-14	2533	2	30.29	2507	4.58
AE-01	2503	1	17.10	2488	2.30
AE-02	2520	1	19.70	2503	2.25
AE-03	2510	1	19.70	2492	2.00
AE-04	2525	1	24.30	2503	2.22
AE-05	2504	1	19.68	2487	2.18
AE-06	2522	1	19.70	2504	2.00
AE-07	2531	1	26.32	2507	1.84
AE-08	2537	1	31.35	2508	2.02
AE-09	2499	1	17.20	2485	2.90
AE-10	2500	1	19.00	2483	2.00
AE-11	2510	1	17.62	2494	2.10
AE-12	2512	1	19.80	2494	2.21
AE-13	2522	1	21.25	2503	1.75
AE-14	2526	1	21.75	2506	1.85
AE-15	2533	1	26.48	2509	2.11
AE-16	2535	1	31.53	2506	2.05
AE-17	2507	1	17.30	2492	1.80
AE-18	2513	1	16.75	2498	1.80
AE-19	2510	1	12.89	2499	1.95
AE-20	2519	1	23.75	2497	1.92
AE-21	2520	1	24.50	2498	2.28
AE-22	2527	1	26.10	2503	2.08
AE-23	2528	1	27.15	2503	1.87
AE-24	2535	1	21.70	2515	2.19
AE-25	2538	1	24.75	2515	2.13
AE-26	2525	1	27.02	2500	1.88
AE-27	2530	1	21.75	2510	1.90
AE-28	2532	1	20.23	2513	1.63
AE-29	2537	1	21.65	2517	2.00
AE-30	2540	1	21.51	2520	1.90
HP-01	2514	2	20.45	2495	1.30
HP-02	2517	2	25.50	2493	1.40
HP-03	2497	2	15.40	2483	1.20
HP-04	2535	2	30.90	2506	1.85
HP-05a	2483	1	7.30	2477	1.10
HP-05b	2494	1	4.40	2490	0.00
HP-05c	2494	1	3.23	2492	1.10
HP-05d	2494	1	--	--	1.10
HP-06	2495	2	15.50	2480	0.90
HP-07	2510	2	20.65	2491	1.90
HP-08	2529	2	24.05	2506	1.45
HP-09	2505	2	25.50	2481	1.95
HP-10	2524	2	25.43	2500	1.45

Notes:
ft = feet
in = inch
ft MSL = feet above mean sea level
ft btoc = feet below top of casing
-- = information not available

Well V-07 was not installed

TABLE 2-2. MAY 2026 FLUID LEVEL GAUGING EVENT
ASH COULEE INCIDENT S316.2
BILLINGS, COUNTY, NORTH DAKOTA

Well ID	Date	DTP (ft btoc)	DTW (ft btoc)	LNAPL Thickness (ft)	Comments	Total Depth - Not recent (ft btoc)
V-01	05/27/26	11.55	12.94	1.39		18.50
V-02	05/27/26	ND	22.63	0.00		23.10
V-03	05/27/26	13.44	13.51	0.07		18.60
V-04	05/27/26	13.87	14.13	0.26		18.10
V-05	05/27/26	NM	NM	NM	Blocked at 18.76	28.10
V-06	05/27/26	ND	22.91	0.00	Missing vent	28.31
V-08	05/27/26	ND	12.50	0.00	Sheen on probe	28.19
V-09	05/27/26	20.59	21.76	1.17		26.50
V-10	05/27/26	15.99	18.46	2.47		20.35
V-11	05/27/26	21.98	25.33	3.35		33.10
V-12	05/27/26	20.03	20.34	0.31	Missing vent	27.95
V-13	05/27/26	19.34	26.41	7.07	Remove PVC to gauge	28.23
V-14	05/27/26	26.13	32.12	5.99		30.29
AE-01	05/27/26	ND	10.21	0.00		17.10
AE-02	05/27/26	18.21	18.23	0.02		19.70
AE-03	05/27/26	NM	NM	NM	Blocked at 13.60	19.70
AE-04	05/27/26	18.90	18.93	0.03		24.30
AE-05	05/27/26	NM	NM	NM	Blocked at 12.22, missing cap	19.68
AE-06	05/27/26	ND	13.09	0.00	Missing cap	19.70
AE-07	05/27/26	ND	20.97	0.00	Missing cap	26.32
AE-08	05/27/26	NM	NM	NM	Blocked at 18.64	31.35
AE-09	05/27/26	ND	10.57	0.00	Black on probe, strong odor	17.20
AE-10	05/27/26	ND	6.00	0.00	Missing cap	19.00
AE-11	05/27/26	14.56	16.00	1.44	Missing cap	17.62
AE-12	05/27/26	NM	NM	NM	Blocked at 14.24	19.80
AE-13	05/27/26	12.03	14.89	2.86		21.25
AE-14	05/27/26	19.01	19.11	0.10		21.75
AE-15	05/27/26	23.26	23.27	0.01	Missing cap	26.48
AE-16	05/27/26	NM	NM	NM	Blocked at 1.03	31.53
AE-17	05/27/26	NM	NM	NM	Blocked at 11.70, missing cap	17.30
AE-18	05/27/26	12.68	12.70	0.02	Sheen on probe	16.75
AE-19	05/27/26	10.92	10.93	0.01	Missing cap	12.89
AE-20	05/27/26	12.13	12.50	0.37	Missing cap	23.75
AE-21	05/27/26	13.05	ND	>8.77	Missing cap	21.82
AE-22	05/27/26	18.14	23.52	5.38	Missing cap	26.10
AE-23	05/27/26	17.75	21.73	3.98		27.15
AE-24	05/27/26	ND	ND	0.00		21.68
AE-25	05/27/26	ND	ND	0.00	Missing cap	24.77
AE-26	05/27/26	19.24	19.60	0.36		27.02
AE-27	05/27/26	17.86	ND	>3.90		21.76
AE-28	05/27/26	17.51	17.81	0.30	Missing cap	20.21
AE-29	05/27/26	ND	21.50	0.00		21.65
AE-30	05/27/26	ND	ND	0.00		21.38
HP-01	05/27/26	ND	16.00	0.00		20.45
HP-02	05/27/26	NM	NM	NM	Blocked at 19.28	25.50
HP-03	05/27/26	9.38	10.70	1.32		15.40
HP-04	05/27/26	ND	23.04	0.00		30.90
HP-05a	05/27/26	ND	5.04	0.00	Missing cap	7.30
HP-05b	05/27/26	NM	NM	NM	Under water	4.40
HP-05c	05/27/26	NM	NM	NM	Under water	3.23
HP-05d	05/27/26	NM	NM	NM	Under water	NM
HP-06	05/27/26	ND	7.38	0.00		15.50
HP-07	05/27/26	14.50	16.71	2.21		20.65
HP-08	05/27/26	18.85	20.04	1.19		24.05
HP-09	05/27/26	12.76	14.89	2.13		25.50
HP-10	05/27/26	16.85	24.95	8.10	Missing cap	25.43

Notes:

ND-fluid was not detected with the probe

NM-Fluid Levels were not measured due to obstruction in casing and probe not able to reach fluids and/or total depth or well was inaccessible

Figures

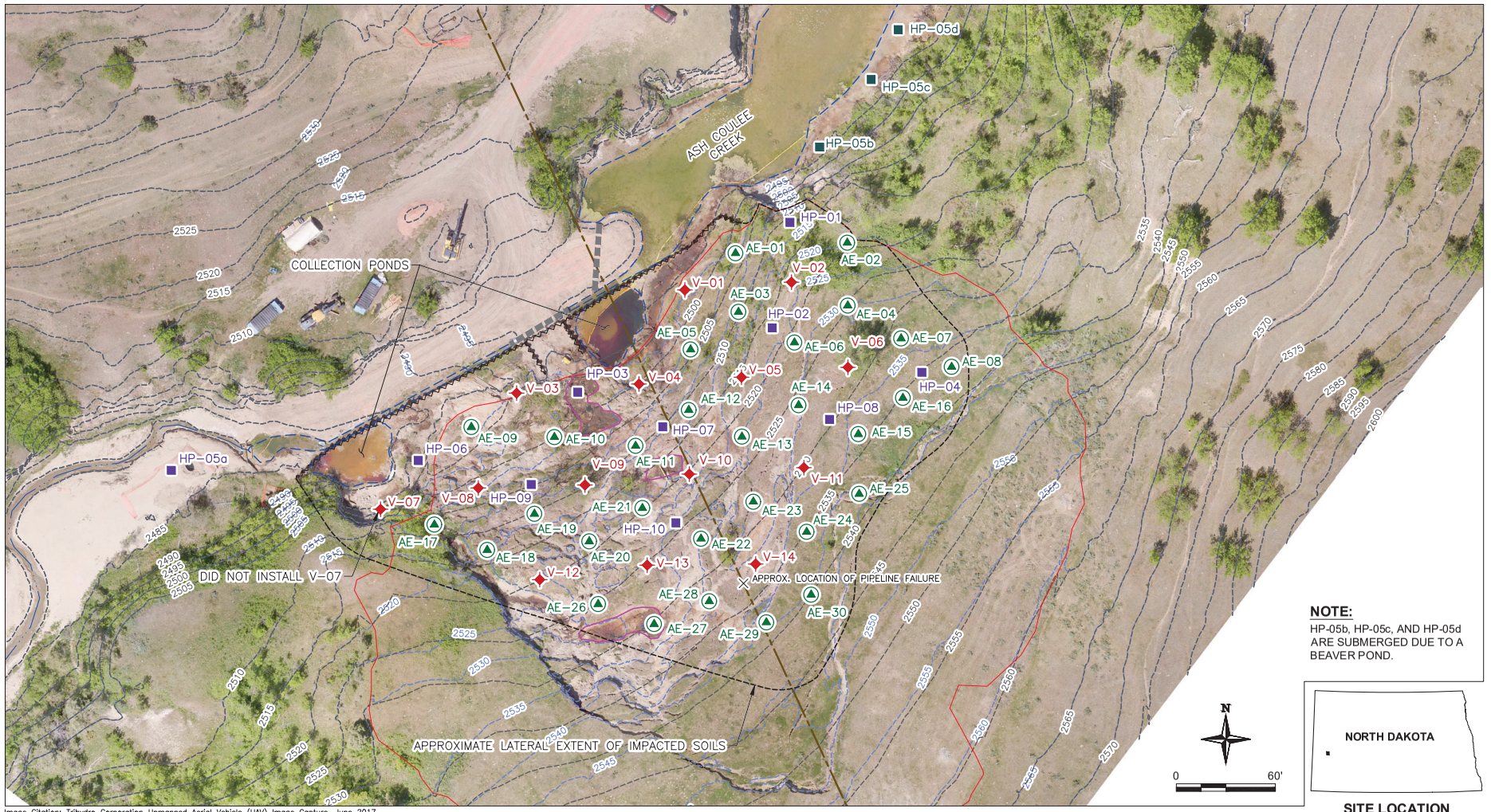


Image Citation: Trihydro Corporation Unmanned Aerial Vehicle (UAV) Image Capture, June 2017

EXPLANATION

AE-26	AIR ENTRY WELL
V-12	PASSIVE TURBINE VENT WELL
HP-05	ISCO INJECTION WELL
HP-05b	INACCESSIBLE ISCO INJECTION WELL
----2560----	MERGED/AS-BUILT CONTOURS (5' INTERVAL)
----2560----	2017 UAV SURVEY CONTOURS (5' INTERVAL)
	CULVERT
	PIPELINE ALIGNMENT - EXISTING
	PRE-GRADE AREAS OF OIL SEEPS
	EDGE OF ASH COULEE CREEK
	CENTER LINE OF ASH COULEE CREEK
	SHEET PILING WALL
	EDGE OF RE-GRADE DISTURBANCE - AS-BUILT

Trihydro Corporation
1252 Commerce Drive
Laramie, Wyoming 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 1-1

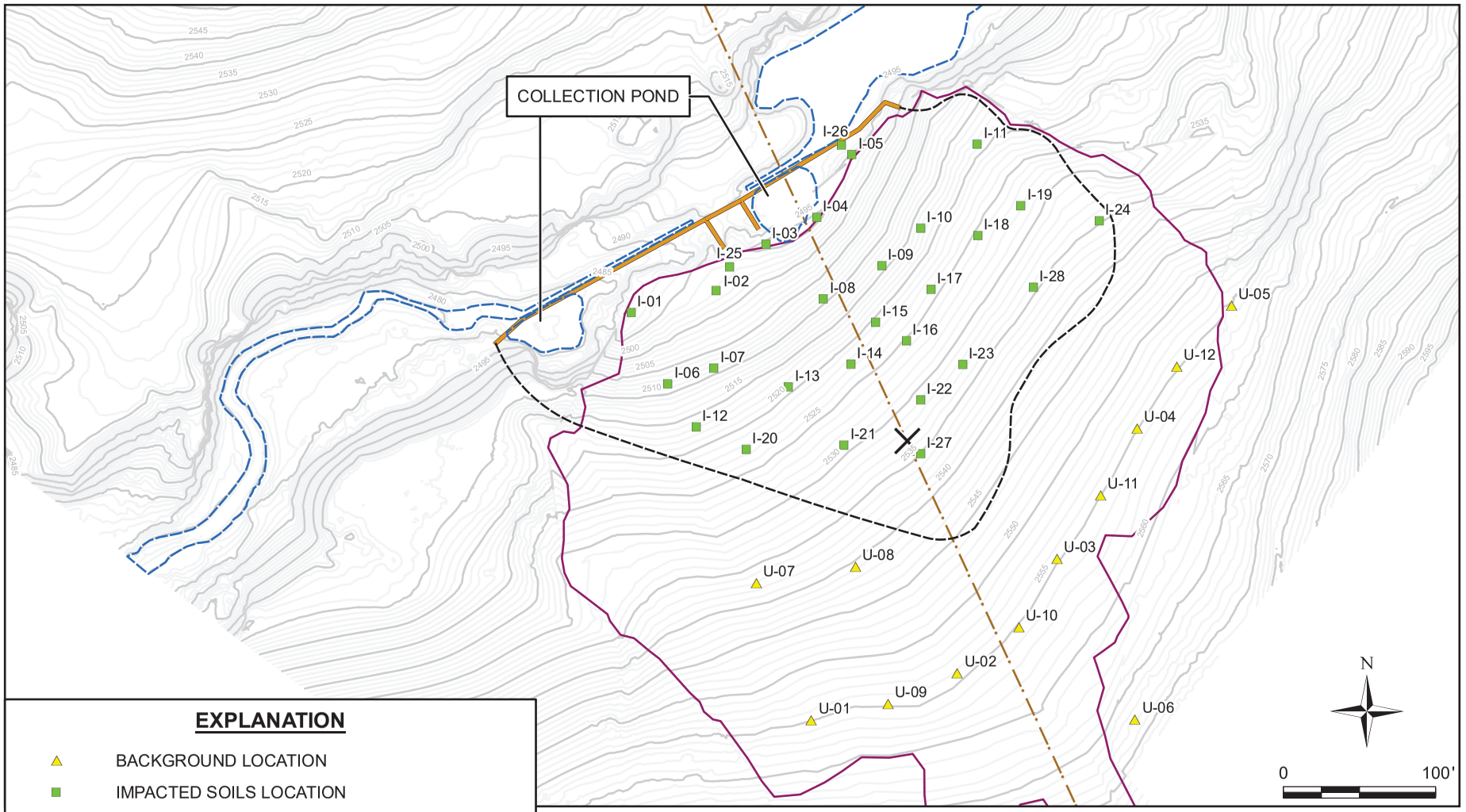
REMEDIATION WELL MAP WITH PRE-GRADE FEATURES

ASH COULEE INCIDENT S316.2
BELLE FOURCHE PIPELINE COMPANY
BILLINGS COUNTY, NORTH DAKOTA

Drawn By: PAC	Checked By: FK	Scale: 1" = 60'	Date: 6/9/2026	File: 758-AC-RWELL-PREGRADE202606

M:\STOV\TRUECOMPANIES\OADD\ASHCOULEE\REMEDYEVALUATION\758-AC-RWELL-PREGRADE202606

Case 1:22-cv-00089-DLH-CRH Document 54-1 Filed 09/09/26 Page 638 of 669



EXPLANATION

- BACKGROUND LOCATION
- IMPACTED SOILS LOCATION
- APPROXIMATE LOCATION OF PIPELINE FAILURE
- ASH COULEE CREEK
- APPROXIMATE LATERAL EXTENT OF IMPACTED SOILS
- PIPELINE ALIGNMENT - EXISTING
- SHEET PILING WALL
- EDGE OF REGRADE DISTURBANCE - AS BUILT

Trihydro CORPORATION
1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 2-1

CARBON DIOXIDE (CO_2) EFFLUX MEASUREMENT LOCATIONS

ASH COULEE INCIDENT S316.2
BELLE FOURCHE PIPELINE COMPANY
BILLINGS COUNTY, NORTH DAKOTA

Drawn By: AML	Checked By: KB	Scale: 1" = 100'	Date: 6/9/26	File: 2-1_CO2_EffluxesLocs

\\TRIHYDRO.COM\CLIENTSISTOVATRUECOMPANIES\GIS\PROJECTS\ASHCOULEE\2025_SOILSREMEDY\2025_SOILSREMEDY.APRX

Case 1:22-cv-00089-DLH-CRH Document 54-1 Filed 09/09/26 Page 639 of 669

Appendix A

Surface Water Sampling Standard Operating Procedure

Standard Operating Procedure (SOP):

Surface Water Sampling at Ash Coulee Creek

Monitoring Following Petroleum Pipeline Release

1. Purpose and Scope

This SOP describes the procedures for collecting monthly surface water samples from Ash Coulee Creek to monitor potential impacts associated with a petroleum pipeline release in 2016. The SOP applies to routine monitoring events involving collection of field measurements and laboratory samples for chloride, pH, total petroleum hydrocarbons as diesel-range organics (TPH-DRO), oil and grease, benzene, toluene, ethylbenzene, and xylenes (BTEX). The objective is to obtain representative, well-documented, and legally defensible samples suitable for laboratory analysis and project decision-making.

2. Responsibilities

- Project Manager: confirms sampling schedule, laboratory coordination, analytical suite, and reporting requirements.
- Sampling Technician(s): verifies site access, safety conditions, equipment readiness, sample labeling, field documentation, collect field measurements and samples in accordance with this SOP, follow decontamination procedures, chain-of-custody completion, and maintain sample integrity.
- Laboratory: provides appropriate sample containers, preservatives, and holding time requirements for the requested analytical methods.

3. Health and Safety

Field personnel shall conduct a site-specific safety review before each sampling event. At a minimum, personnel shall wear sturdy boots, and disposable nitrile gloves when handling sample containers or potentially affected water. Additional PPE such as high-visibility clothing, chemical-resistant outer gloves, or waders shall be used as needed based on weather, terrain, water depth, bank stability, and the potential presence of petroleum sheen, odor, or other hazards. Personnel shall avoid direct contact with impacted water and shall not enter unsafe channels, steep banks, or areas with unstable footing. If visible product, strong vapors, or other acute hazards are encountered, sampling shall stop and the condition shall be reported to the Project Manager for further direction.

4. Equipment and Supplies

- Laboratory-supplied sample bottles and preservatives for chloride, pH (if required by project), TPH-DRO, oil and grease, and BTEX analyses
- Calibrated field meter(s) for pH, dissolved oxygen, and water temperature
- Cooler(s) with ice or frozen gel packs sufficient to maintain samples at approximately 6°C or below
- Chain-of-custody forms and field logbook
- Waterproof sample labels and indelible marker
- Disposable nitrile gloves
- GPS-enabled device or field tablet/phone for location documentation
- Camera or mobile device for site photographs, if required
- Sampling pole, dipper, or other clean sampling device, as needed for safe access to flowing water
- Deionized rinse water for decontamination
- Trash bags for waste PPE and disposable materials

5. Pre-Sampling Preparation

1. Confirm the monthly sampling date, site access conditions, and any landowner or right-of-entry requirements.
2. Coordinate with the laboratory in advance to obtain the correct bottle kit, preservatives, minimum volumes, and current holding times for the analytical methods requested.
3. Review the sampling plan, previous monitoring results, and designated sample location(s) at Ash Coulee Creek.
4. Calibrate field meters as required according to the manufacturer’s instructions.
5. Prepare sample labels before entering the field when practical, including project name, location, sample identification, date, time, preservative (if applicable), and sampler initials.
6. Prepare the cooler with sufficient ice or gel packs before sample collection begins.

6. Sample Locations

1. WO-13 (upstream)
   GPS Coordinates: 47.10840°N; -103.36714°W
2. WO-14 (downstream)
   GPS Coordinates: 47.10539°N; -103.36980°W

3. WO-15 (downstream)
   GPS Coordinates: 47.11299°N; -103.39960°W

7. Field Sampling Procedure

7.1 Arrival and Site Inspection

Upon arrival, inspect the sampling area and document general site conditions, weather, recent precipitation if known, water appearance, flow conditions, odor, staining, and the presence or absence of petroleum sheen or other visible impacts. Photographs may be collected to document stream conditions and sampling location.

7.2 Selection of Sampling Point

Collect samples from the designated monitoring points at Ash Coulee Creek: WO-13 (upstream), WO-14 (downstream), and WO-15 (downstream). When conditions allow, collect from a well-mixed portion of the creek that best represents flowing conditions, avoiding stagnant edge water. Minimize disturbance of bottom sediments. If depth or bank conditions make direct access unsafe, use a clean sampling pole or dipper.

7.3 Order of Activities

1. Put on new disposable gloves before sample collection.
2. Measure and record field pH, dissolved oxygen, and water temperature directly in the creek or in a clean container filled immediately from the creek, following meter-specific instructions.
3. Collect volatile organic compound samples for BTEX first to minimize loss of volatile constituents.
4. Collect TPH-DRO samples next.
5. If oily sheen is visible on the water’s surface, collect oil and grease samples next.
6. Collect chloride and any remaining water chemistry samples last.
7. Place all samples on ice immediately after collection.

7.4 Sample Collection Method

Face upstream where practicable and collect the sample from the upstream side of the sampler to reduce the potential for contamination from disturbed sediment or personal contact. Use the laboratory-provided container whenever direct filling can be safely accomplished. If an intermediate device is required, it shall be clean and decontaminated before use. Sample bottles shall not be overhandled, and bottle caps shall be kept clean and placed face up or otherwise protected from contamination during filling.

7.5 Analyte-Specific Handling

- pH: Measure in the field at the time of sampling using a calibrated meter. Record the reading, time, temperature if available, and calibration verification; may also be collected in the laboratory-supplied plastic container for analysis.
- BTEX (benzene, toluene, ethylbenzene, xylenes): Use laboratory-provided volatile organic analysis vials. Fill carefully to avoid turbulence and headspace. Do not allow bubbles or headspace to remain in the vial if zero-headspace containers are provided. Preserve, store, and ship exactly as directed by the laboratory.
- TPH-DRO: Use the laboratory-specified container and preservative, if any. Avoid cross-contamination from fuels, equipment exhaust, dirty gloves, or contact with petroleum-containing materials. Preserve, store, and ship per laboratory instructions.
- Oil and Grease: Use the laboratory-specified container and preservative, if any. Avoid overfilling or transferring between containers unless specifically required by the method or laboratory. Oil and Grease samples are only necessary if an oily sheen is visible on the water's surface. Preserve, store, and ship per laboratory instructions.
- Chloride: Collect in the laboratory-provided container and preserve, if required, according to laboratory instructions.

7.6 Decontamination

If reusable sampling equipment is used, decontaminate it between sample locations and at the end of sampling using a clean water rinse. Disposable gloves shall be changed between sample handling tasks whenever contamination is suspected.

8. Quality Assurance / Quality Control

At a minimum, field staff shall follow consistent sampling techniques, equipment calibration procedures, chain-of-custody requirements, and sample cooling requirements for each event. Project-specific QA/QC samples such as field duplicates, equipment blanks, trip blanks for volatile samples, or field blanks should be collected when required by the sampling plan, laboratory, regulator, or Project Manager. Any deviations from this SOP shall be documented in the field record and reported with the data package.

9. Documentation

- Project name and sampling location: Ash Coulee Creek

- Date and time of collection
- Sampler name(s)
- Weather and site conditions
- GPS coordinates or clear description of the sample point
- Observed water conditions, including flow, clarity, sheen, odor, or staining
- Field pH result and calibration record if pH is not collected in laboratory-supplied container
- Sample identification numbers and requested analyses
- Preservation, cooler identification, and relinquishment details
- Any deviations, problems encountered, or corrective actions taken

10. Sample Handling, Storage, and Shipment

Immediately after collection, place all laboratory samples in a cooler with ice or frozen gel packs to maintain the temperature required by the laboratory, typically approximately 6°C or below. Protect glass containers from breakage. Complete the chain-of-custody form for all samples and seal the cooler, if required by the project. Samples shall be shipped via Fedex Priority Overnight to the laboratory as soon as practicable and within applicable holding times. Laboratory bottle type, preservative, and holding time requirements shall govern if they differ from general project assumptions.

11. Corrective Actions and Deviations

If a sample cannot be collected as planned because of unsafe access, dry conditions, frozen conditions, excessive turbidity, equipment failure, or other field constraints, document the issue in the field record and notify the Project Manager. Any substitution of location, alternate collection method, or missed sample event shall be clearly documented and justified in the monitoring record.

12. References

Referenced guidance includes current U.S. Environmental Protection Agency surface water sampling procedures and North Dakota petroleum release sampling guidance. Project-specific laboratory instructions for container selection, preservatives, and holding times shall also be followed for each event.

Appendix B

Blank Field Forms

Well ID	Date	DTP (ft btoc)	DTW (ft btoc)	LNAPL Thickness (ft)	Comments
V-01					
V-02					
V-03					
V-04					
V-05					
V-06					
V-08					
V-09					
V-10					
V-11					
V-12					
V-13					
V-14					
AE-01					
AE-02					
AE-03					
AE-04					
AE-05					
AE-06					
AE-07					
AE-08					
AE-09					
AE-10					
AE-11					
AE-12					
AE-13					
AE-14					
AE-15					
AE-16					
AE-17					
AE-18					
AE-19					
AE-20					
AE-21					
AE-22					
AE-23					
AE-24					
AE-25					
AE-26					
AE-27					
AE-28					
AE-29					
AE-30					
HP-01					
HP-02					
HP-03					
HP-04					
HP-05a					
HP-05b					
HP-05c					
HP-05d					
HP-06					
HP-07					
HP-08					
HP-09					
HP-10					

Site Location:

Field Personnel:

Location	Offset	AM			PM			Comments
		Date	Time	LICOR Reading	Date	Time	LICOR Reading	
I-01								
I-02								
I-03								
I-04								
I-05								
I-06								
I-07								
I-08								
I-09								
I-10								
I-11								
I-12								
I-13								
I-14								
I-15								
I-16								
I-17								
I-18								
I-19								
I-20								
I-21								
I-22								
I-23								
I-24								
I-25								
I-26								
I-27								

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Location	Offset	AM			PM			Comments
		Date	Time	LICOR Reading	Date	Time	LICOR Reading	
I-28								
U-01								
U-02								
U-03								
U-04								
U-05								
U-06								
U-07								
U-08								
U-09								
U-10								
U-11								
U-12								

Case 1:22-cv-00089-DLH-CRH Document 54-1 Filed 09/09/26 Page 649 of 669

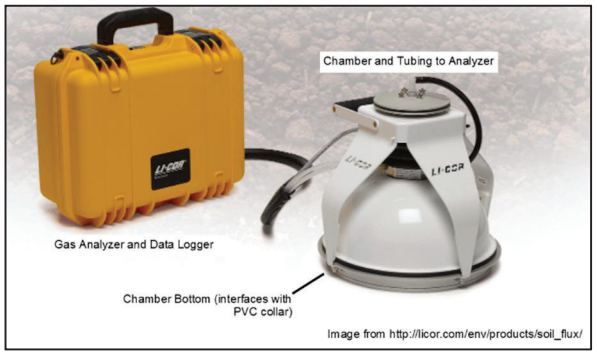
Appendix C

NSZD Data Collection Standard Operating Procedures

Appendix A-1. Standard Operating Procedure – LI-COR Soil Collar Installation

1.0 PURPOSE

This standard operating procedure (SOP) provides general methods for installing polyvinyl chloride (PVC) collars for LI-8100A 20 centimeter (cm) chamber soil gas efflux measurements. The LI-COR LI-8100A system and a soil collar are shown in the images below.







The chamber is placed onto a soil collar for a short time (approximately 3 minutes). Soil gas concentrations build up in the chamber and are logged by the portable gas analyzer. The CO_2 concentration versus time curve is used to estimate a CO_2 gas flux. This SOP describes procedures for soil collar installation that can increase the representativeness of data collection.

2.0 PLANNING

This section includes basic planning elements for LI-COR collar installation.

2.1 VARIABLES

The following variables should be considered when installing the soil collars for the LI-8100A 20 cm survey chamber:

Collar dimensions – For LI-8100A survey chambers, the PVC collar is typically a thick-walled eight inch PVC sewer pipe (Schedule SDR35). An outer diameter of 21.34 cm (8.4 inches) is necessary to ensure a tight seal between the LI-COR chamber and the soil interface. A 20 cm soil collar can be purchased from LI-COR (www.licor.com) under part number 6581-044, or can be constructed according to the mechanical specifications shown in Image 2-1. The beveled edge on the bottom of the collar is recommended but optional. Its purpose is to make for easier and cleaner insertion of the collar into the soil profile. However, if the soil is first augered or shoveled, the beveling does not provide any

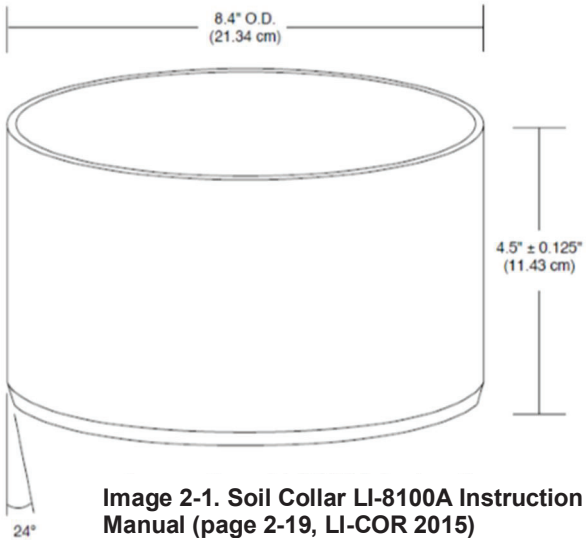


Image 2-1. Soil Collar LI-8100A Instruction Manual (page 2-19, LI-COR 2015)

additional benefit. If deemed necessary, the beveled edge can be achieved using a grinder, coarse file, or a large lathe.

Collar installation depth – The minimum collar depth should be that which provides a solid foundation for the chamber. There is a tradeoff with increased installation depth. The deeper the collar, the greater the reduction in lateral diffusion. However, a deeper collar increases the chances of root shearing; creating non-representative degradation of plant matter. Finally, the depth of the collar affects the height it extends above ground surface. Generally, a soil collar should extend 2 to 3 cm above ground surface. Greater heights are acceptable, but they create non-representative conditions with shading and evaporation (LI-COR 2012). Overall, aim for a collar depth that gives you 2 to 3 cm of height above ground surface unless you think this depth will damage underlying roots. It can be difficult to install the additional 8 to 10 cm into the ground to achieve this depth, so if necessary the height of the soil collar could be reduced before installation to make them easier to install; but at least 4 cm of the collar should be in the ground with soil comparcted around the sidewalls to prevent atmospheric air leakage into the sample chamber.

2.2 EQUIPMENT

The following equipment is recommended for soil collar installation:

- Required personal protective equipment (PPE), listed in the site-specific safety plan
- Utility locations and proper documentation/permits
- 20 cm diameter PVC soil collars
- Possible equipment for soil that is amenable to direct insertion of the collars:
  - Rubber mallet and wood board for lightly pounding collars to depth
  - Flat screwdriver or other safe blade for creating channel of appropriate depth around the circumference of the collar
- Possible equipment for soils not amenable to direct insertion of collars
  - Shovel
  - Portable hand auger
  - Auger attached to skid-steer loader:



http://www.evansrental.com/ConstructionEquipment/tabid/7317/galleryType/SlideShow/ItemID/2529/AlbumID/542/Default.aspx

3.0 PROCEDURES

A good collar installation is one that provides a solid foundation for the chamber and is as representative of undisturbed conditions as possible. The specific method will depend on the soils at the site, and it is possible that the method from one location to the next will vary as the soils vary. The ideal installation is one in which the collar is inserted directly into the soil to the target depth. This is the method of least disturbance to the soil. However, sometimes the soils have to be temporarily dug out, the collar placed, and then the soil backfilled within and around the collar. In all cases, follow these procedures.

1. Clear surface vegetation from the soil collar area. If inserting the collar directly, use a rubber mallet to drive the collar into the soil. It may be helpful to lay a piece of wood across the collar and drive with the mallet to insert the collar evenly.
2. Allow at least a few hours (ideally 24 hours) between collar installation and LI-COR measurements.
3. Make the top of the collar as level as possible.
4. After collar installation, measure the height of the collar that extends above the soil (i.e., the collar offset). This height is used in the calculation that converts measured gas concentrations to fluxes. If the height of the collar above the soil is uneven, take several measurements so that an average can be calculated (north side, south side, east side, west side).

If the collar can be inserted directly to the soil, there are no additional procedures to mention. If the soil must first be temporarily dug out, follow these procedures.

1. Dig a hole with a slightly larger diameter than the collar to the target depth. Stage the soils to the side of the hole.
2. Place the collar in the temporary hole, making the top as even as possible.
3. Replace the soils in the hole and around the collar. As you do this, remove any larger root fragments. Those roots, since they are no longer connected to a living plant, may start to decay and create non-representative respiration. Additionally, take care not to add any rocks that are unrepresentative of the soil profile.
4. Pack the backfilled soils lightly within and outside the collar. You want a solid foundation, but also do not want to overly compact soils and render them not representative of the native conditions. The level of packing should be similar within and outside the collar so that you don't create a preferential path for gases on either side.

It is important to note, the collars may become loose over time and should be moved if this occurs.

4.0 REFERENCE

LI-COR. 2015. Using the LI-8100A Soil Gas Flux System and the LI-8150 Multiplexer. LI-COR, Inc. Publication Number 984-11123. 1st Printing: May, 2010. 2nd Printing: July, 2012. 3rd Printing: August, 2015.

Appendix A-2. Standard Operating Procedure – Dynamic Closed Chamber (LI-COR) Setup and Measurement of CO_2 Effluxes

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the methods to set up and measure ground surface CO2 effluxes with a dynamic closed chamber as an indicator of natural source zone depletion (NSZD) of petroleum hydrocarbons. The dynamic closed chamber is placed on a PVC soil collar and collects CO_2 that exits ground surface for a short time period (e.g., 2 minutes). With a measured CO_2 concentration increase within the chamber, measured air temperature, measured air humidity, and known chamber dimensions, it is possible to calculate the CO_2 flux into the chamber. The dynamic closed chamber that Chevron typically uses is the LI-8100A (LI-COR Biosciences, Lincoln, Nebraska). The LI-8100A can be assembled to collect survey measurements or long-term automated measurements with a multiplexer. Further material related to the operation and maintenance of the LI-8100A can be found in the Manual (LI-COR 2015A).

2.0 PLANNING

This section includes basic planning elements for connecting to the LI-8100A, programming the LI-8100A, collecting CO_2 flux measurements, and accessing these measurements.

2.1 EQUATION SUMMARY LIST

Relevant equations are listed here and explained in context throughout this SOP.

$$RPD = \left[\frac{|J_{CO2,exp} - J_{CO2,lin}|}{(J_{CO2,exp} + J_{CO2,lin})/2}\right] \times 100\% \quad (1)$$

$$J_{CO2,T} = \frac{10VP_0\left(1-\frac{W_0}{1000}\right)}{RS(T_0+273.15)}\frac{dC\prime}{dt} \quad (2)$$

$$J_{CO2,BGC} = J_{CO2,T} - BG_{ave} \quad (3)$$

$$J_{CO2,14C} = \left(\frac{1-F^{14}C}{1.05}\right)(J_{CO2,T}) \quad (4)$$

$$J_{TPH} = (J_{CO2,BGC})\left(\frac{1\ mol\ CO_2}{10^6 \mu mol\ CO_2}\right)\left(\frac{1\ mol\ C_{10}H_{22}}{10\ mol\ CO_2}\right)\left(\frac{142\ g\ C_{10}H_{22}}{1\ mol\ C_{10}H_{22}}\right)\left(\frac{86400\ s}{1\ day}\right) \quad (5)$$

2.2 VARIABLES

Controlling Device. When collecting measurements using the LI-8100A, the unit can be controlled using a wired computer connection or wireless through an iOS or Android device. Using a computer allows the surveyor to save results to the hard drive immediately following a measurement and to determine whether there were errors that would require the re-measuring at that location. Using the wireless iOS or Android device connection allows the user to more easily control the equipment in the field. For this SOP two methods are described to use the wireless connected devices.

- iOS device version 8.4.1 and older will use a Cisco® Systems wireless card to establish the wireless connection.
- iOS devices running iOS 9.0 and newer or Android devices will use a TP-LINK wireless router to establish the wireless connection.

The iOS version 9 was published in 2015, so most devices will likely use this second method of connection, but both methods are described in Section 2.3 of this SOP as well as in the LI-8100A manual (LI-COR 2015a). Whichever method does not apply can be skipped in Section 2.3 of this SOP and the user should proceed to the Connecting to Auxiliary Sensors section within Section 2.3 of this SOP.

Measurement Timeframe. The LI-8100A can be assembled to collect survey measurements or long-term automated measurements with a multiplexer. This SOP focuses on the survey measurement capabilities. The LI-8100A User Manual discusses long-term setup for the LI-8100A.

Measurement Replication and Averaging: CO_2 effluxes at a given soil collar vary over the course of a day. If a long-term chamber is set up, then measurements can be taken frequently (e.g., once every 15 minutes) at one soil collar and the values can be averaged to obtain a 24-hour average. If there is a time gap in the measurements (e.g., due to a temporary power loss on the instrument), then the practitioner can used weighted averaging of the measurements to account for the lost time on the instrument. Alternatively, "gap filling" (e.g., through a documented correlation between ambient temperature and CO_2 efflux) can be applied.

If a survey chamber is used, then replicate measurements can be taken at a given soil collar to represent the 24-hour average better than a one-time measurement. Replicates should be taken at different times of day (e.g., morning versus afternoon) and then averaged. The replicates do not need to be on the same day, but generally should be during the same week (to be in a similar weather regime). The practitioner should establish during the planning stage the proportion of the soil collars (e.g., 25%, 50%, 100%) that will receive replicate measurements. Replicates at any proportion less than 100% should be spread at an even spatial distribution so that each area of the site is achieving a similar density of replication. Simple averaging of survey chamber replicates is acceptable for current practice.

Background Location versus ^{14}C Measurement. There are two methods for measuring the background CO_2 efflux. One method is to visit an area absent of petroleum contamination, with similar soil types and vegetation to those present above the LNAPL body and collect a CO_2 efflux sample to compare to the measurements above the LNAPL body. A second method is to measure the radiocarbon (^{14}C) content of the CO_2 exiting ground surface above the LNAPL body.

2.3 EQUIPMENT

The following equipment list is comprehensive for obtaining CO_2 efflux data:

- **LI-8100A:** The LI-8100A is used to measure soil CO_2 efflux. The LI-8100A can be configured to collect single survey measurements with a portable chamber, or can be deployed for long term measurements with up the 16 chambers and a multiplexer. The two main components of the LI8100A are the Analyzer Control Unit (ACU) and the Survey Chamber.
  - **Analyzer Control Unit:** The ACU is equipped with an infrared gas analyzer to measure the concentration of CO_2 as it cycles through an attached chamber. The unit also contains the data storage memory card and wireless connection card.
  - **Survey Chamber:** The dynamic chamber is placed on a soil collar and cycles the headspace gases through the ACU while minimizing pressure gradients in the subsurface. The 20-centimeter (cm) model is typically used by Chevron.
- **Computer:** A personal computer is used to connect to the instrument and retrieve measurement data. The computer should be equipped with the LI-8100A software to communicate and control the LI-8100A, as well as the SoilFluxPro™ software to review and analyze measurements. An RS-232 serial cable to the USB adaptor is used to connect the computer to the ACU.
- **iOS or Android Device:** This device is used to connect wirelessly to the LI-8100A and to control the functions of the LI-8100A to collect field measurements.
- **Wireless Card or Router:** A Cisco® Systems wireless card can be used to establish a wireless connection between the LI-8100A and an iOS device version 8.4.1 and older. A TP-LINK wireless router is used with the LI-8100A to connect to an iOS device running iOS 9.0 and newer or an Android OS devices.
- **Soil Temperature and Moisture Probe:** These instruments are optional for measurements with the LI-8100A unit, but can be used to collect additional data, such as the soil temperature and moisture content while the LI-8100A is collecting a CO_2 efflux measurement.

3.0 PROCEDURES

This section includes procedures

3.1 INSTRUMENT SETUP

Connecting to the LI-8100A: This section describes the connection from the Analyzer Control Unit (ACU) to a personal computer.

1. Install the computer software for the LI-8100A from the LI-COR website (www.licor.com/env/support).
2. Install a charged battery to the LI-8100A and press the **ON/OFF** button to turn the analyzer control unit on.
3. Connect the RS-232 serial cable to the USB adaptor and connect the computer through a USB port and the ACU through the serial cable as shown in Image 3-1.

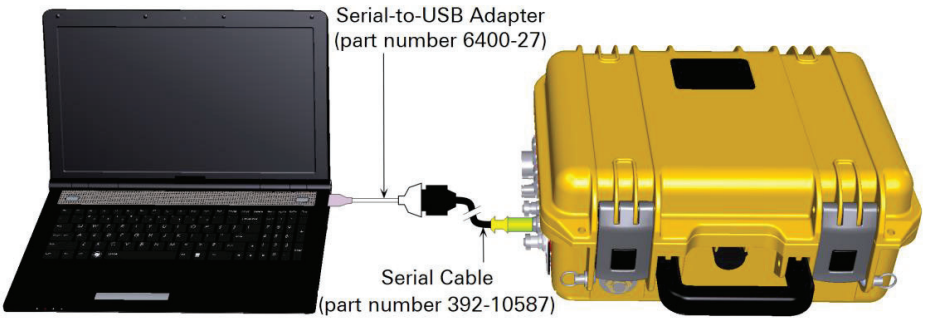


Image 3-1. Computer to ACU Connection (LI-COR, 2015B)

4. After the LI-8100A is on, the pump should start running and about a minute later the Ready light should turn on. Start up the LI-8100A software on the computer and select the **Connect** button. Find the **USB Serial Port** when prompted for the **Port #** and select **Connect** again.
5. While the instrument is connected, set the date and time under **8100>Date and Time**.

Wireless Connection to LI-8100A Device (Method 1): These instructions are for any iOS version 8.4.1 and older and an LI-800A equipped with a Cisco® Systems wireless card.

1. While the LI-8100A is connected to the computer, in the LI-8100A software go to **8100>Networking** to set the IP Address and Netmask. Fill the Remote Networking Setup according to Table 2-1 and as shown in Image 3-2. Leave encryption unchecked in this setup.

Table 2-1. Remote Networking Setup Information

IP Address	192.168.100.101
Netmask	255.255.255.0
Connection Type	Peer-to-Peer
Network Name (SSID)	Soil Network 1
Channel	1
IP Address (iOS)	192.168.100.100
Subnet Mask	255.255.255.0

2. In iOS, select **Settings>Wi-Fi** and connect to Soil Network 1.
3. After selecting the network connection, under **IP ADDRESS** select **Static** and input the IP Address (iOS) and Subnet Mask from Table 2-1.

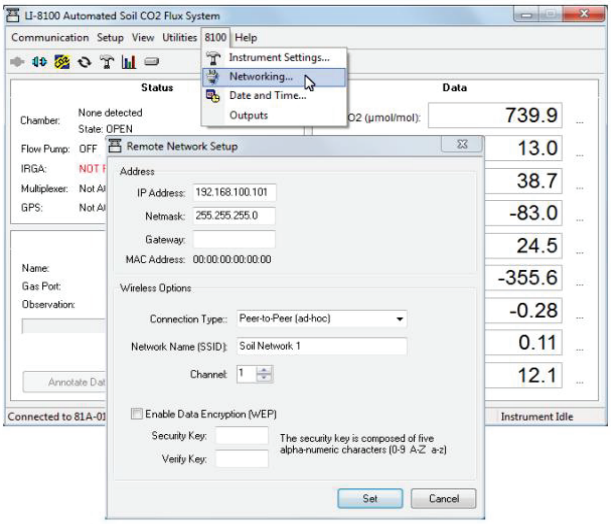


Image 3-2. Remote Networking Setup (LI-COR, 2015B)

4. Download the **LI-8100APP** to your iOS device. Launch the Application and select **Connect to Instrument>New**, type and save the LI-8100A's IP address (192.168.100.101). Select the IP Address that was typed in and tap **Connect** as shown in Image 3-3.

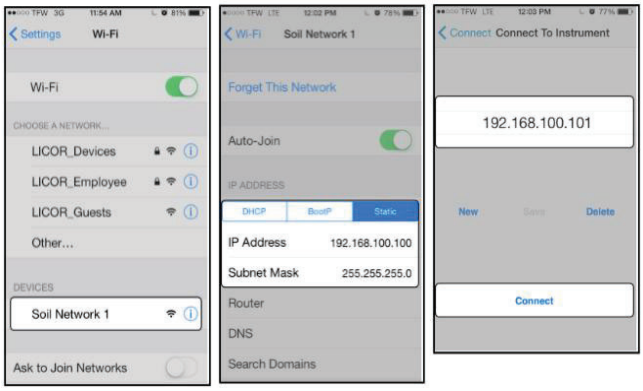


Image 3-3. iOS Connection Procedures (LI-COR, 2015B)

Wireless Connection to LI-8100A Device (Method 2): These instructions are for any iOS version 9 and newer or Android operating system device. This instruction describes the installation of the TP-LINK wireless router. The Cisco® Systems wireless card should be removed from the ACU prior to this procedure.

1. Install a charged battery in the TP-LINK wireless router and power it on. The power LED should be green or orange and not blinking.
2. Switch the mode on the side of the TP-LINK to the position labeled WISP or 3G/4G.
3. Connect your computer to the wireless network from the TP-LINK wireless router. The network name and password are printed under the batter cover of the TP-LINK.

Table 2-2. Wireless Settings

Username	Admin
Password	Admin
Start IP Address	192.168.0.100
End IP Address	192.168.0.199
Default Gateway	192.168.0.1

4. Open a web browser and type 192.168.0.1 in the address bar and press Enter. Log in credentials will be shown on the browser where the information in Table 2-2 should be input.
5. Select **DHCP** on the setup page and set the IP Address range to the values in Table 2-2.
6. Connect the computer to the LI-8100A as described in **Connecting to the LI-8100A.**
7. In the LI-8100A software, select **8100>Networking**. Configure the wireless settings so the IP Address is identical to the TP-LINK IP Address for the first three sets of numbers (192.168.0) and outside the start and end range shown in Table 2-2 for the last set; a value such as 192.168.0.200 would be appropriate. Select **Set** to apply the settings. See Image 3-4 and Table 2-2 for wireless settings selections.

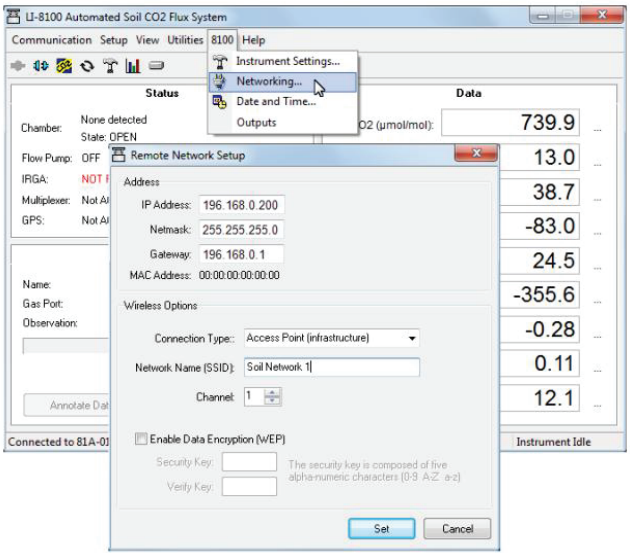


Image 3-4. Wireless Settings in LI-8100A Software (LI-COR, 2015B)

8. Connect the router to the Ethernet port on the CompactFlash adapter under the access panel as shown in Image 3-5.
9. Connect an iOS or Android device to the wireless network from the TP-LINK. The network name and password are printed under the battery cover of the TP-LINK.
10. Download the LI-8100APP to the iOS or Android device. Launch the Application and select **Connect to Instrument>New**, type and save the LI-8100A's IP Address (192.168.100.101). Select the IP Address and select **Connect** as shown in Image 3-4.

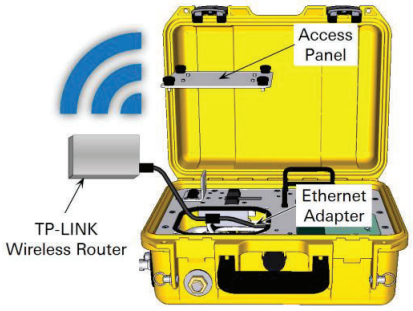


Image 3-5. Wireless Router Connection (LI-COR, 2015B)

Connect Auxiliary Sensors: The LI-8100A can be equipped with additional sensors for recording soil moisture and temperature at the measurement location. Two common sensors, described in the LI-8100A Manual, are the Omega Probe to measure soil temperature and moisture and the EC-5 to measure soil moisture only.

1. Wire the sensors to the auxiliary sensor interface, route the sensor cables through the interface gland plugs and connect them to the interface terminals as shown in Image 3-6.
2. In the LI-8100A phone application select **TI-8100A>Auxiliary Inputs** and under Thermocouple 1 select E for the Omega Probe.

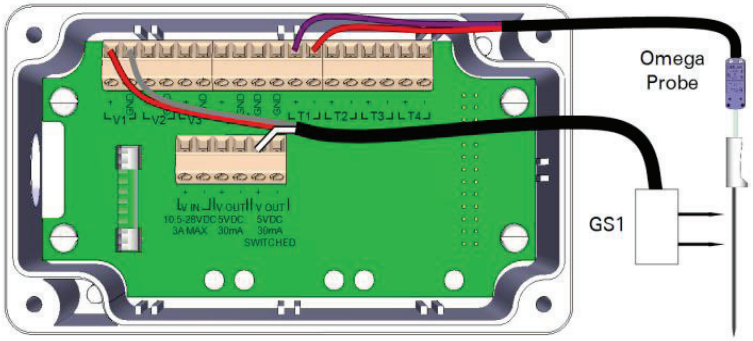


Image 3-6. Sensor Wiring Diagram (LI-COR, 2015B)

3. In the LI-8100A phone application select **TI-8100A>Auxiliary Inputs** and under the voltage input channel select **SM** and enter the **Slope** and **Offset** from Table 2-3 or refer to the instrument manual to determine soil specific coefficients.

Soil Type	Slope	Offset
Mineral	0.494	-0.554
Soilless Media	0.591	-0.661

Table 2-3. Soil Specific Coefficients (LI-COR, 2015A)

3.2 FIELD MEASUREMENT

This section describes the procedures to connect to the survey chamber, program the field measurement, and collect the measurement. It should be noted that a fully charged battery will last for about 2 to 3 hours of operation. Batteries are the preferred method for powering the unit, because they are often a safer approach to powering the instrument than a generator.

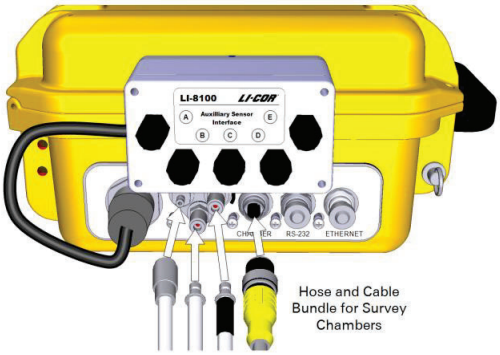


Image 3-7. Survey Chamber Connection (LI-COR, 2015B)

1. Connect the survey chamber to the LI-8100A according to the Image 3-7.
   - **AIR IN** is for the flow of air from the chamber to the ACU.
   - **AIR OUT** returns air back to the chamber after it has been analyzed in the ACU.
   - **BELLOWS** drives the survey chamber to open and close.

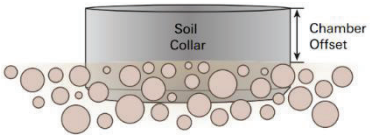


Image 3-8. Chamber Offset (LI-COR, 2015B)

2. Measure the chamber offset prior to conducting the CO_2 efflux measurement. The collar offset is the stickup height of the collar above the soil, as shown in Image 3-8. Use a ruler to measure four points in a cross-pattern of the collar. Average these four values for the chamber offset.
3. Prior to programing the LI-8100A using the LI-8100A Application, the user should:
   - Mobilize to a pre-set soil collar. Position the analyzer control unit so that the chamber and auxiliary probes can reach the collar area without pulling on the tubes and cables.
   - Place the chamber onto the collar. It should sit evenly on the collar. Insert the auxiliary probes into the adjacent ground.
4. In the LI-8100A Application, program the measurement cycle. The measurement cycle starts with a pre-purge period with the chamber open and the pump on. Upon initiating the observation the chamber closes with the pump remaining on through the observation. After closing the dead band starts and the instrument begins logging data. The chamber opens again for the post-purge follows the observation. See Image 3-9 for the measurement cycles.

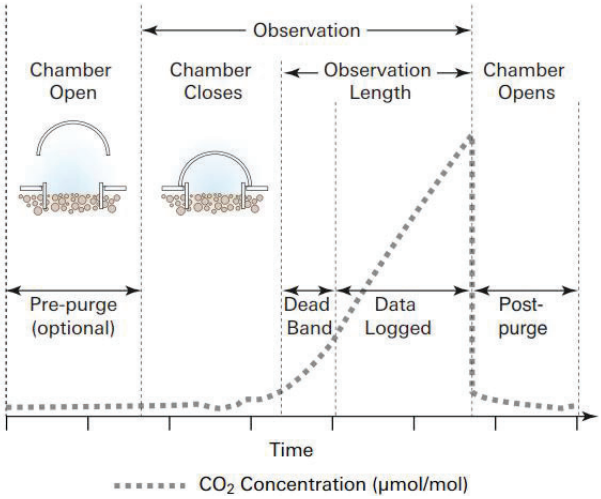


Image 3-9 Measurement Cycle (LI-COR, 2015B)

- In the LI-8100A Application select **Setup>Measurement Protocol**; the measurement times in Table 2-4 are recommended. The Chamber Offset should be input under **Setup>Areas and Volumes**.
- After inputting any remaining data in the application, select **Start Measurement**. This command will prompt the user to select a file name and a location to log data.
- Finally, select **Start** to initiate the measurement. Stay clear of the chamber as it closes over the collar and takes a measurement. It should be noted, it is also possible to connect to the LI-8100A via the COM cable to your computer and control the collection of measurements through the LI-8100A software. An advantage of using a computer is that when taking measurements in the field one can immediately back up the data on your hard drive.

Table 2-4. Measurement Times

Obs. Length	2:00
Dead Band	0:30
Pre-Purge	1:05
Post-Purge	0:45

5. After the measurement is complete or at the end of the day, retrieve the CompactFlash card from the adaptor under the access panel of the analyzer control unit. Remove the access panel by loosening the four thumbscrews and finding the adaptor as shown in Image 3-10. Use the SoilFluxPro® software to access and analyze CO_2 flux data from the LI-8100A.



Image 3-10. CompactFlash Card Location (LI-COR, 2018)

- After the measurement is collected, review the reported efflux, checking the concentration vs. time pattern in the SoilFluxPro® software. See Section 3.3 for examples of acceptable data plots.
- Once you have a representative measurement, move to the next location and continue. CO_2 effluxes vary over time, so as possible return to some (e.g., 25%, 50%, 100%) of the locations at a different time of the day (doesn't have to be the same day) and repeat the measurement.

3.3 QUALITY ASSURANCE / QUALITY CONTROL

The CO_2 concentration versus time recorded by the dynamic closed chamber software needs to be reviewed to assess whether the data are of sufficient quality to calculate a CO_2 efflux. Data quality is based on a roughly linear average trend in CO_2 accumulation over the data collection period. To access the CO_2 concentration over time plots:

1. Open the SoilFluxPro® software on a computer.
2. Select **Open** and browse for the data file downloaded from the LI-8100A.
3. Find the file name that was assigned to the measurement and select that measurement. A window will appear with information about the measurement and the CO_2 concentration over time plot. Manipulation of this plot (i.e. removing start/end data, linear/versus exponential fit) can be done in the side bar prompts available in the pop-up window. Following any changes to the plot, select **Compute Again** to generate a new plot.

Leak Testing Procedures: Some minor fluctuations around the mean linear trend may be expected and acceptable, as shown in Image 3-11 and 3-12. Unacceptable non-linear behavior or suspicious /anomalous data trends (see Image 3-13 and 3-14) would trigger a required equipment integrity assessment (e.g., tests for leaks) and a repeat of data collection to confirm or validate results. An equipment integrity assessment can be as simple as disconnecting and reconnecting tubing, followed by re-running the measurement. In addition, LI-COR provides procedures for a rigorous test to identify leaking connections or tubes as follows:

1. Close the tubing loop for each port to be tested. This can be accomplished by joining the male and female connectors on the chamber tube or by connecting a leak test shunt (LI-COR Part Number: 9981-142).
2. In the LI-8100A Application, go to **Utilities>Manual Controls** and select **Leak Test**.
3. Select **Port Sequence** under the **Leak Test** options, choose the port to test, and go through all ports where the tubing loop is closed.
4. Select **Send Updates** to start the test. Results will include: p-pass, f-fail, x-canceled o-in queue, and - -not tested.

Example CO_2 Concentration versus Time Plots: Below are four examples of types of CO_2 concentration versus time plots and considerations for data quality.

Example 1

This is a good CO_2 concentration versus time plot. The concentration is increasing in an approximate linear trend. Theoretically, no trend would be exactly linear if diffusion is the dominant transport mechanism. Over long timeframes, the CO_2 concentration trend would eventually flatten out or plateau as the concentration in the chamber approaches the concentration in the soil. But over short timeframes such a plateau should be difficult to discern, and the trend should be approximately linear. Some "waviness" occurs as the CO_2 concentration cycles above and below the regression line in this example. This is possibly due to imperfect mixing in the chamber. This is typical and overall it is possible to place a representative regression line onto the data.

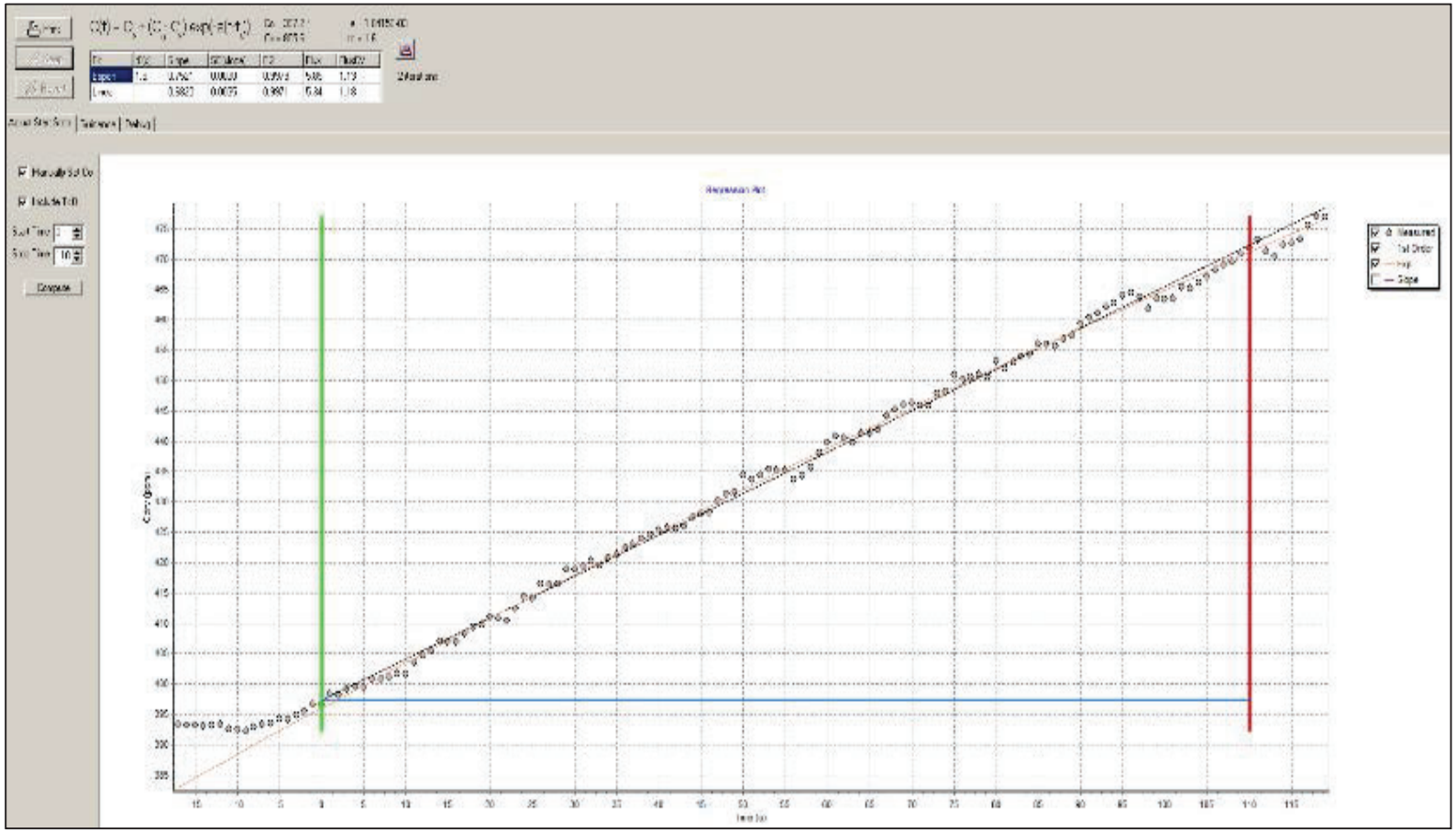


Image 3-11. Steadily increasing CO_2 concentration versus time plot.

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Example 2

This is an acceptable CO_2 concentration versus time plot. The concentration is increasing in an approximate linear trend. Moderate "waviness" is observed. This often happens when the rate of CO_2 concentration increase is not strong, making the possibly imperfect mixing within the chamber more evident. Despite the waviness, the overall trend does appear to be linear, with possible flattening out toward the end of the measurement. The possible flattening out is clipped from the regression fitting.

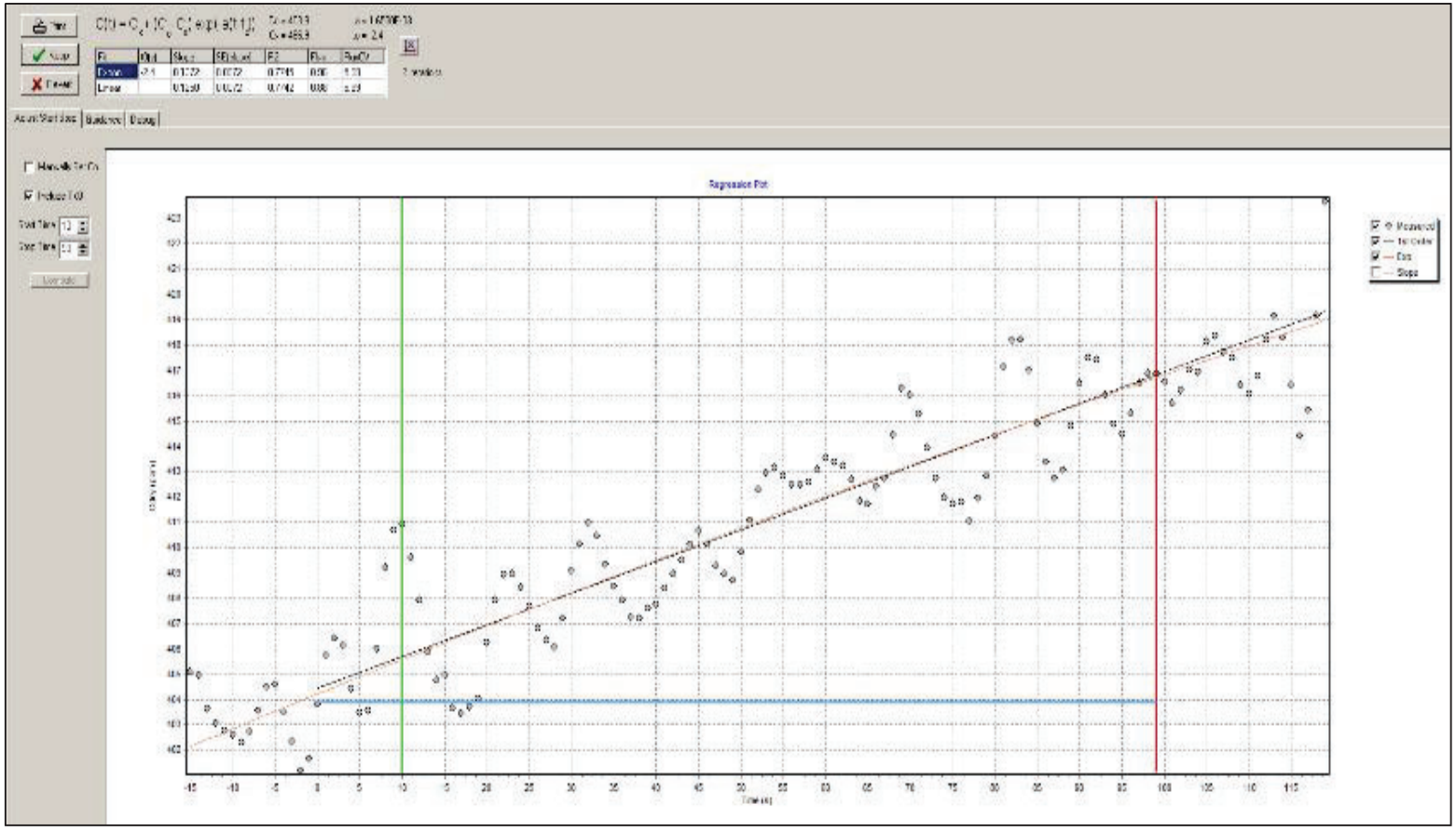


Image 3-12. Moderately "wavy" increasing CO_2 concentration versus time plot.

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Example 3

This is an unacceptable CO_2 concentration versus time plot. Perhaps there is an overall increasing trend, but a couple of peaks in CO_2 concentration are far separated from the regression line. The field worker observed this trend and checked the fittings on the system. A connector on the tubing was discovered as not fully attached. Apparently, this was allowing atmospheric air to enter the tubing, leading to the poor reading by the instrument.

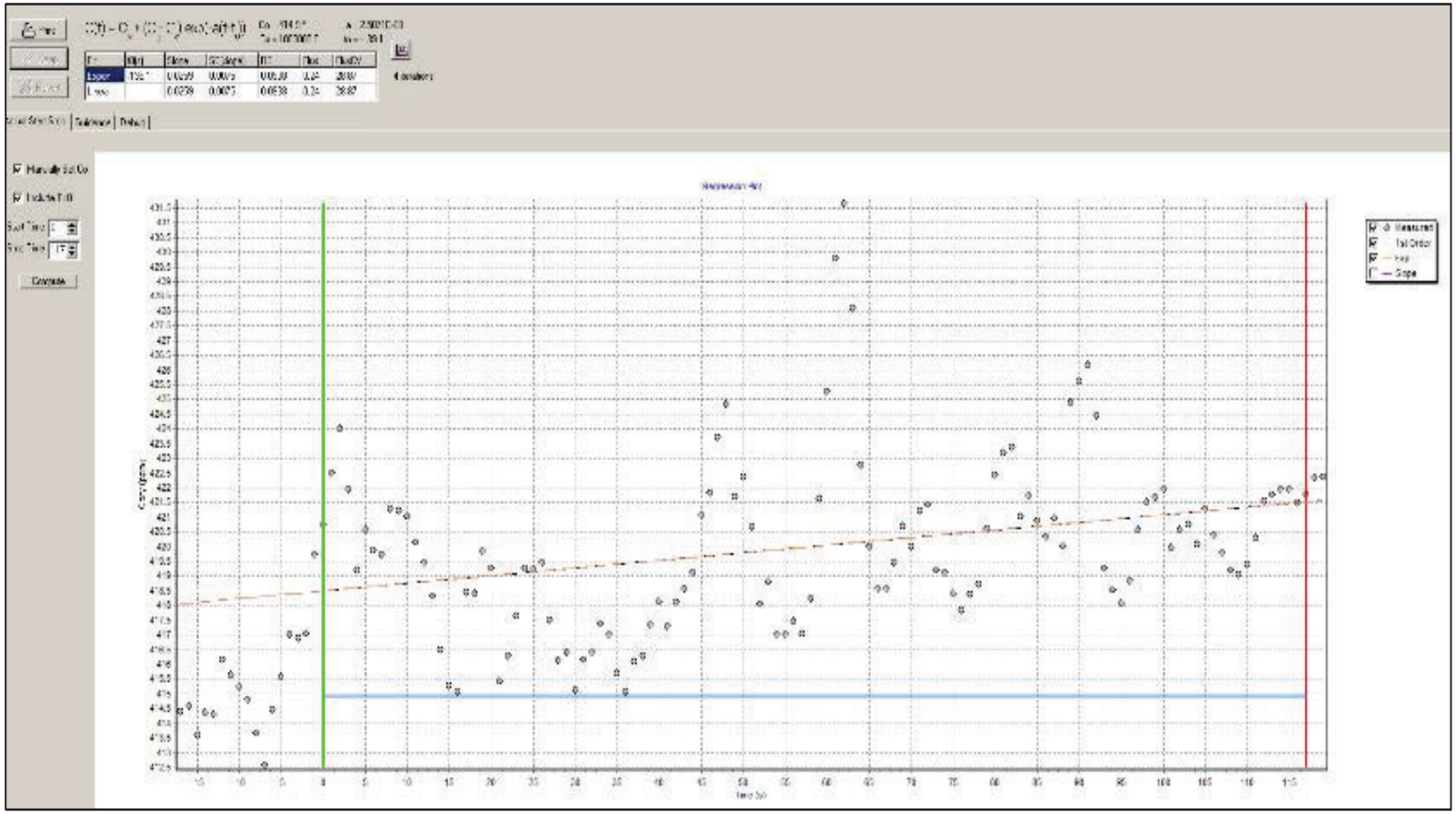


Image 3-13. Very "wavy" CO_2 concentration versus time plot with an ambiguous trend.

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Example 4

This is an unexpected CO_2 concentration versus time plot. The concentration is decreasing in an approximate linear trend. It appears to be indicating that CO_2 is exiting the chamber and entering the soil. While it may be acceptable for use, a repeat data collection is required to confirm the trend is real and not due to equipment malfunction or analyzer error. This might be an indication that the CO_2 concentration in the soil is lower than atmospheric (diffusion) or that the pressure in the soil is lower than atmospheric (advection), or it could indicate an error on the gas analyzer. If it is confirmed, then the data appear representative. For the purposes of calculating a source depletion rate or for averaging, the best practice protocol is to set the CO_2 efflux to zero at locations exhibiting negative efflux. A reported negative flux, when converted to a hydrocarbon "loss" rate, would have a physically impossible interpretation that hydrocarbons are being created.

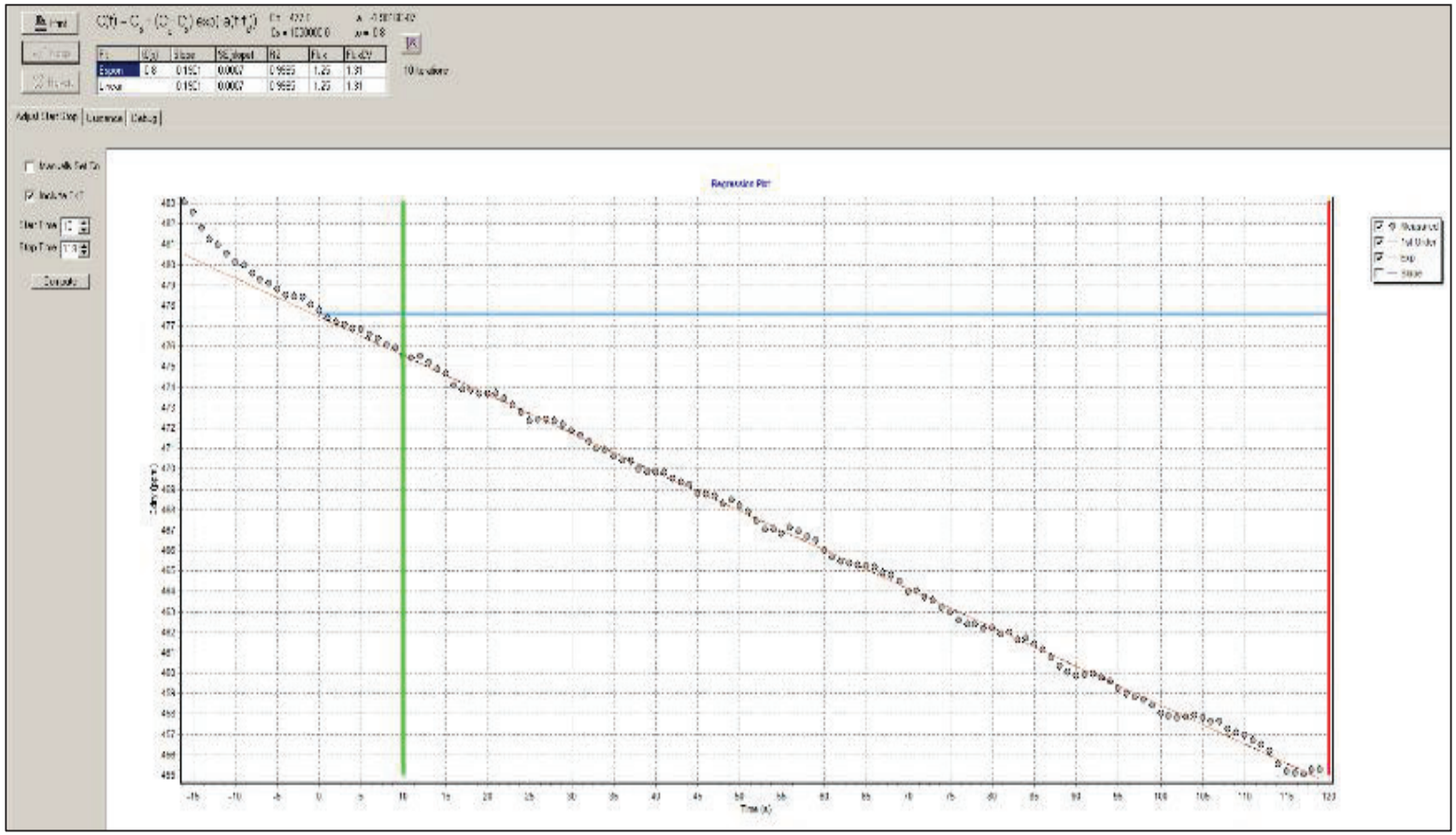


Image 3-14. Decreasing CO_2 concentration versus time plot.

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3.3 DATA PROCESSING PROCEDURES

Calculate CO_2 Effluxes: When using the LI-8100A equipment, CO_2 efflux should be estimated using the built-in SoilFluxPro® data processing software that uses the CO_2 concentration versus time trend, measured temperature, and measured humidity. In order to best estimate a CO_2 efflux concentration using the SoilFluxPro® software:

1. Adjust the regression start and end time to select an approximate linear portion of the plot.
2. Select **Compute Again** to generate a new plot following any changes to the plot area or starting concentration (C_0). The parameter C_0 represents the CO_2 concentration at the time the chamber closes, so generally it is acceptable to use the value selected by the software even if the time start and end are adjusted.
3. Move the C_0 concentration in the regression analysis if the R^2 value remains less than 0.95 after changing the start and end time of the regression.
4. Compare the relative percent difference (RPD) of the exponential flux and the linear flux.

$$RPD = \frac{|J_{CO2,exp} - J_{CO2,lin}|}{(J_{CO2,exp} + J_{CO2,lin})/2} \times 100\% \qquad (2)$$

   Where $J_{CO2,exp}$ is the exponential CO_2 flux and $J_{CO2,lin}$ is the linear CO_2 flux in the regression analysis (µmol CO_2 m^{-2} s^{-1}).

   If the RPD is greater than 25%, adjust the regression start and end time or the C_0, until the RPD is less than 25%. An RPD greater than 25% is acceptable if the reason is understood (e.g., RPDs can be high for low efflux values), but such data points should be noted in the report. Otherwise, reject the data point.

5. Instead of using the SoilFluxPro® software, data can be input to Equation 2 below to estimate the CO_2 efflux (LI-COR Biosciences 2012). This approach is recommended for when calculating fluxes with multiple collars due to the simplicity of handling soil collar heights in excel compared with the LI-COR software:

$$J_{CO2,T} = \frac{10VP_0\left(1 - \frac{W_0}{1000}\right)}{RS(T_0 + 273.15)}\frac{dC'}{dt} \qquad (2)$$

   where $J_{CO2,T}$ is the CO_2 efflux (µmol CO_2 m^{-2} s^{-1}), V is the volume of the chamber and soil collar (cm^3), P_0 is the initial pressure in the chamber (kPa), T_o is the initial air temperature in the chamber (°C), and dC'/dt is the regression on the water-corrected CO_2 mole fraction in air (µmol mol^{-1}).

NSZD Rate Estimate by Background Correction: To estimate NSZD rates based on CO_2 efflux measurements, the natural soil respiration should be subtracted from CO2 effluxes measured above the LNAPL body. One option is to conduct "background correction." For this method, measure CO_2 effluxes in an area absent of petroleum contamination, with similar soil types and vegetation to those present above the LNAPL body. Identification of areas absent of contamination are best identified with soil data (e.g., hydrocarbon concentrations in soil), but can also be based on groundwater samples collected from monitoring wells if boring log data indicates a vadose zone free of hydrocarbons. The CO_2 effluxes in a background area should be measured in several (at least three and ideally ten or more) locations to obtain a robust measure of the average and data spread to estimate background efflux. The average background CO_2 efflux must be less than the average CO_2 efflux above the LNAPL body, and ideally the two averages should be significantly

different on a statistical (e.g., student's t) test. Therefore, this method is recommended at sites with low background effluxes and variability (e.g., semi-arid or arid sites). More humid sites with high background effluxes and variability may still be viable for this method with sufficiently large sample sizes.

Once the average background CO_2 efflux is measured and confirmed different from the average CO2 efflux above the LNAPL body, conduct these data processing steps:

1. Subtract the average background concentration (BG_{ave}) from the average CO_2 efflux measured above the LNAPL body ($J_{CO2,T}$). This yields an average background-corrected sitewide CO_2 efflux ($J_{CO2,BGC}$) in units of µmol CO_2 m^{-2} s^{-1} (or µmol C m^{-2} s^{-1} since one mole CO_2 contains one mole of carbon).

$$J_{CO2,BGC} = J_{CO2,T} - BG_{ave} \qquad (3)$$

2. If calculating a location specific NSZD rate, set the calculated value to zero if the corrected CO_2 efflux value results in a negative value. The interpretation for a zero value is that the CO_2 efflux associated with hydrocarbon biodegradation cannot be distinguished from the background CO_2 efflux.
3. Include error bars (e.g., standard error) if graphing average sitewide values, as appropriate.

NSZD Rate Estimate by Radiocarbon (^{14}C) Correction: An alternative approach for estimating NSZD rates is to measure the ^{14}C content of CO_2 exiting ground surface and use this to calculate the proportion attributable to hydrocarbon biodegradation. Because CO_2 generated from hydrocarbon biodegradation contains no ^{14}C, the ^{14}C content in the CO_2 exiting ground surface can assist in quantifying the proportion that was previously hydrocarbons. This method is recommended for background correction at sites where there are not areas absent of petroleum contamination (or this cannot be established with current available data), or where background areas are so high or have so much variability that CO_2 effluxes there are essentially indistinguishable from those measured above the LNAPL body or source area.

The procedure for collecting a ^{14}C measurement from a static chamber is described in Appendix A-3. If ^{14}C samples were collected, the reported fraction modern carbon ($F^{14}C$) will be used to estimate the CO_2 efflux associated with hydrocarbon biodegradation using the following equation:

$$J_{CO2,14C} = \left(\frac{1-F^{14}C}{1.05}\right)\left(J_{CO2,T}\right) \qquad (4)$$

where $J_{CO2,14C}$ is the ^{14}C corrected CO_2 efflux (µmol CO_2 m^{-2} s^{-1}), $J_{CO2,T}$ is the uncorrected CO_2 efflux measured from the LI-8100 gas analyzer (µmol CO_2 m^{-2} s^{-1}), and $F^{14}C$ is the fraction ancient carbon for the ^{14}C sample provided by the analytical laboratory. The 1.05 is used to normalize to the approximate current fraction of modern carbon in the atmosphere (Sihota and Mayer 2012).

Convert to Hydrocarbon Units: To estimate a quantity of hydrocarbons destroyed by biodegradation, it is often useful to convert from units of µmol CO_2 m^{-2} s^{-1} to units of g TPH m^{-2} day^{-1} (J_{TPH}). Practitioners typically use decane ($C_{10}H_{22}$) as a representative hydrocarbon molecule to represent an approximate average-weight LNAPL or TPH. The conversion is as follows for a background-corrected CO_2 efflux:

$$J_{TPH} = \left(J_{CO2,BGC}\right)\left(\frac{1\ mol\ CO_2}{10^6 \mu mol\ CO_2}\right)\left(\frac{1\ mol\ C_{10}H_{22}}{10\ mol\ CO_2}\right)\left(\frac{142\ g\ C_{10}H_{22}}{1\ mol\ C_{10}H_{22}}\right)\left(\frac{86400\ s}{1\ day}\right) \qquad (5)$$

If ^{14}C samples were collected, replace $J_{CO2,BGC}$ with $J_{CO2,14C}$ in the equation above.

4.0 REFERENCES

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